NUCLEAR SCIENCE ABSTRACTS

Volume 28 Number 11

Abstracts 26954-29571

December 15, 1973

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Volume 28, Number 11, December 15, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

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DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
DIERCKX, R., Determination of the fast neutron spectrum at the L54 reactor core center, 27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

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ACCELERATOR FACILITIES/DESIGN
Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
Pulse radiolysis of alkyl ketones, 27:24388
Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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ORNL-		
4811	**27-21462**	**Dep. NTIS, 133p.**
4840	**27-19984**	**Dep. NTIS, 8p.**
4846	**27-21102**	**Dep. NTIS $4.00, 44p.**
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31	**27-22013**	**Dep. NTIS, 87p.**
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34	**27-22016**	**Dep. NTIS, 89p.**
35	**27-22017**	**Dep. NTIS, 98p.**

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 27061, 29057, and 29470.

26954 PITFALLS IN THE DETERMINATION OF ENVIRONMENTAL TRACE METALS. Hume, D. N. (Massachusetts Inst. of Tech., Cambridge). AT(11-1)-2169. pp 3-16 of Chemical Analysis of the Environment and Other Modern Techniques. Ahuja, S. (ed.). New York; Plenum Publishing Corp. (1973).

The need for highly sensitive and selective methods for the analysis of trace elements at the parts per billion level in environmental samples is discussed. Results of an interlaboratory comparison of colorimetric analyses of water for trace elements are given; standard deviation ranges from 19 to 43%, errors from −67 to +26%. A striking lack of agreement is also noted in results from an intercalibration study on the determination of Fe in seawater by various methods including neutron activation analysis, atomic absorption spectroscopy, colorimetry, etc. Four particular problems that must be kept in mind are contamination, loss of constituent, matrix effects, and sampling. (JGB)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 27375, 27479, and 27483.

26955 (BNWL-1751(Pt. 2), pp 24-25) DETERMINATION OF SILVER IN SEAWATER BY ANION EXCHANGE AND INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Robertson, D. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A neutron activation method is described for the determination of silver in seawater in which anion exchange is used to concentrate the silver before activation. The detection limit is 0.002 μg Ag/l for 1 l sample and the precision is approximately ± 10% at a concentration of about 0.01 μg Ag/l. (DHM)

26956 (BNWL-1751(Pt. 2), pp 26-28) DETERMINATION AND OCCURRENCE OF ARSENIC IN THE OCEANS. Robertson, D. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A neutron activation method is described for determining arsenic in seawater consisting of quantitative coprecipitation with $Fe(OH)_3$ and irradiation for 5 h in a thermal neutron flux of 5×10^{12} n/cm^2/sec and counting the ^{76}As. (DHM)

26957 (BNWL-1751(Pt. 2), pp 56-57) NEUTRON ACTIVATION ANALYSIS OF COAL AND FLYASH STANDARDS. Rancitelli, L. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

National Bureau of Standards samples of coal and flyash were analyzed for 25 major-minor and trace elements by instrumental neutron activation analysis. The samples were irradiated for one minute in a neutron flux of 10^{13} n/cm^2/sec, and permitted to decay 10 minutes to remove a major interference, ^{28}Al, prior to a Ge(Li) gamma-ray analysis. This technique permitted the direct measurement of Al, Br, Cl, Cu, Mg, Ti and V by comparison with the standards. A second neutron irradiation for 6 hours in a neutron flux of 2×10^{12} n/cm^2/sec was performed to measure the elements Co, Cr, Cs, Eu, Fe, Hg, Hf, La, Na, Sb, Sc, Se, Sm, Sr, Ta, Tb and Th. These samples were then permitted to decay for four days prior to a γ-ray analysis of the neutron-induced activities, ^{24}Na, ^{140}La and ^{151}Sm. About 20 days after the irradiation, the samples were again counted for 100 minutes on a Ge(Li) detector to measure the long-lived neutron activation products. All elements with the exception of Mg and those elements which were at or below the detection limits of the technique, Cl, Br, Cu and Hg, were measured to an accuracy of 5 to 10%. (DHM)

26958 (BNWL-1751(Pt. 2), pp 62-63) TRACE ELEMENT CHARACTERIZATION OF URBAN AEROSOLS BY X-RAY FLUORESCENCE AND NEUTRON ACTIVATION ANALYSIS. Cooper, J. A.; Rancitelli, L. A.; Tanner, T. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The x-ray fluorescence technique is based on the direct excitation of the elements in the filter with high-intensity radioisotopic sources and their analysis using a Si(Li) detector. The use of 100 mCi ^{55}Fe, ^{109}Cd and ^{241}Am sources provides for the rapid and inexpensive measurement of S, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Ge, Br, Sr, Zr, Mo, and Pb in air filters mounted in 35 mm slides. Quantitative results are obtained both by comparing the air filter results to thin film standards and by using those elements measured by neutron activation as internal standards. The neutron activation procedure involves a one-minute irradiation of the filter samples together with the appropriate standards at a neutron flux of 10^{13} to 10^{4} n/cm^2/sec. The sample and standards are allowed a 10 minute decay interval to reduce interference from ^{28}Al. They are then counted for 5 minutes on a Ge(Li) gamma-ray spectrometer. This permits the simultaneous measurement of Na, Mg, Al, Cl, Ti, V, Mn and Br. The samples and standards are then reirradiated to an integral neutron exposure of 10^{17} n/cm^2, allowed to decay for 5 and 20 day periods and counted on a Ge(Li) gamma-ray spectrometer for 30 and 100 minutes, respectively. The 30 minute count permits the measurement of Na, K, Ca, As, Br, La, Sm, and U, while the 100 minute count measures the concentration of Sc, Cr, Fe, Co, Zn, Se, Rb, Ag, Sb, Ta, Cs, Hf, Eu, Tb, Hg, and Th. (DHM)

26959 (BNWL-1751(Pt. 2), pp 88-89) DETERMINATION OF TOTAL BODY CALCIUM BY MEASURING ^{37}Ar IN EXPIRED AIR AFTER LOW-LEVEL IRRADIATION WITH 14 MeV NEUTRONS. Palmer, H. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A method for determining total-body calcium by measuring the ^{37}Ar in expired air after low-level irradiation with 14-MeV neutrons was developed using rats, however current studies are under way toward application of the method to human patients. Advantages of this method for measuring total body calcium over existing methods using in vivo neutron activation include: a much lower irradiation dose; fewer and less expensive facilities and equipment; and greater accuracy. (DHM)

26960 (BNWL-SA-4671) MULTIELEMENT CHARACTERIZATION OF ATMOSPHERIC AEROSOLS BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS AND X-RAY FLUORESCENCE ANALYSIS. Rancitelli, L. A.; Cooper, J. A.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, Wash.).

1973. Contract AT(45-1)-1830. 23p. (CONF-730839-1). Dep. NTIS $3.25.

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Helsinki, Finland (27 Aug 1973).

Neutron activation methods for analyzing air filters for Al, Br, Cl, Mg, Mn, Na, Ti, V, As, La, Sm, Co, Cr, Eu, Fe, Hf, Hg, Sb, Sc, Se, Ta, Tb, Th, and Zn are described. X-ray fluorescence methods for quantitatively measuring Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Br, Sr, Zr, Mo, Cd, Sn, Ba, and Pb and for semiquantitatively measuring Na, Mg, Al, Si, S, Cl, K, and Ca are also presented. (DHM)

26961 (TID-26452) DETERMINATION OF METAL CONTAMINATION IN PUERTORICAN FOODS USING INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Benitez Rodriguez, J. (Puerto Rico Univ., Mayaguez). Jul 1972. 51p. Dep. NTIS $4.75.

Thesis.

Instrumental neutron activation analysis (NAA) was applied to the detection of heavy metal contamination of foods. A high-resolution Ge(Li) detector was employed, coupled to a 1024 channel analyzer. The interferences due to ^{24}Na and ^{82}Br were reduced by allowing the samples to decay for 7 to 10 days. The samples (approximately 1 gm.) were sealed in polyethylene vials and irradiated for 8 hours, together with standards, at the PRNC Triga Reactor at a flux of approximately 10^{13} n/cm^2 sec. They were counted for 30 minutes live time. High concentrations of Hg, Cd, and As were found in most samples. The daily intake of Hg, As, Cd, and Co by the average Puertorican was calculated and found to be substantially higher than values from other places reported in literature. (auth)

26962 ANALYSIS OF METAL SURFACES BY THE DIRECT OBSERVATIONS OF NUCLEAR REACTIONS. Beranger, G. (Ecole Nationale Superieure des Mines, Paris). pp 7-10 of Surface States and Transformations. Paris; Compagnie Francaise d'Editions (1972). (In French).

From technical meeting on surface states and transformations; Paris, France (7 Jun 1971).

A method is presented for the analysis of light elements present at the surface of metals which is based on the direct observation of nuclear reactions. The principle of the method is described and examples of its applications are given concerning the analysis of impurities on the surface of metals: after chemical polishing of zirconium; after electrolytic polishing of copper; and mechanical polishing of zirconium. (FR)

26963 NEUTRON ACTIVATION ANALYSIS OF TURKISH LIGNITES. Akcetin, S.; Ayca, E.; Hoste, J. (Univ., Ghent). Radiochem. Radioanal. Lett.; 15: No. 1, 13-28(20 Sep 1973).

Qualitative and quantitative neutron activation analysis of five kinds of lignites, which are very abundant and still used as a cheap fuel in Turkey, is described. (auth)

26964 NEUTRON ACTIVATION ANALYSIS OF MICROIMPURITIES IN LITHIUM. I. Determination of Vanadium and Niobium after Preseparation with α-n-nonylpyridine-N-oxide. Gilbert, E. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR); Glukhov, G. G.; Mecheriakov, R. P.; Mikhailov, V. A.; Torgov, V. G. Radiochem. Radioanal. Lett.; 15: No. 1, 33-38(20 Sep 1973).

Neutron activation analysis of V and Nb in lithium and its compounds is shown to be possible only after preseparation from the matrix. Methods were developed for the rapid separation of V and Nb by selective extraction with α-n-nonylpyridine-N-oxide. (auth)

26965 PROTON ACTIVATION ANALYSIS OF WATER SAMPLES. Bankert, S. F. Davis, CA; Univ. of California (1972). 149p. University Microfilms Order No. 73-19,073.

Thesis (Ph. D.).

The problems encountered and the progress made in developing a proton activation analysis technique for use on water samples are described. The result is a NaI-Ge(Li) anti-coincidence gamma ray detector system combined with a fast pneumatic transport system. The technique is capable of detecting ppM quantities of boron, nitrogen, bromine, selenium, sodium, cadmium, and chromium in water samples which are first concentrated and then evaporated onto tantalum foils. The activating particles are 14.7 MeV protons at beam currents of the order of one microampere. (Diss. Abstr.)

26966 DETERMINATION OF SOME MEDIUM AND HIGH Z ELEMENTS USING CHARGED PARTICLE ACTIVATION ANALYSIS. Riddle, D. C. College Station, TX; Texas A and M Univ. (1973). 109p. University Microfilms Order No. 73-21,698.

Thesis (Ph. D.).

Utilizing proton reaction products in the 1-second to 1-minute half-life range, nondestructive analyses for Se, Br, Y, Zr, La, Pr, Dy, and Nd were carried out in metallurgical and biological samples. The experimental detection limits found vary from a few parts per million to a few parts per thousand depending on the matrix-impurity combination considered. In addition a number of proton and ^{3}He-ion reaction products with half-lives from 1 to 5 minutes were examined for trace analysis possibilities. A comprehensive survey was made of all possible activation reactions with protons, deuterons, and ^{3}He-ions of up to 40 MeV and ^{4}He-ions of up to 50 MeV. The reactions found to be best suited for sub-ppM determinations were for lead: $^{206,207}Pb(d,xn)^{206}Bi$; for thallium: $^{203,205}Tl(p,xn)^{203}Pb$; and for bismuth: $^{209}Bi(p,3n)^{207}Po$. The pertinent activation curves (relative excitation functions) were established and radiochemical separation procedures for the respective product nuclides were devised and evaluated. The feasibility of nondestructive and destructive analyses was studied on a series of high purity materials with heavy metal concentrations in the ppM to ppB range using the methods described, and the analytical results are presented and discussed. Estimated detection limits are 0.01 ppM for lead and 0.001 ppM for both bismuth and thallium for 12 μ Ampere-hour irradiations. In addition to the procedure for the determination of total lead, a method is presented for the determination of $^{204}Pb/^{206}Pb$ isotope ratios. (Diss. Abstr.)

26967 ACTIVATION ANALYTICAL METHODS FOR THE ANALYSIS OF ORGANIC COMPOUNDS. Erdtmann, G.; Nuernberg, H. W. (Kernforschungsanlage, Juelich, Ger.). pp 762-813 of Methodicum Chimicum. Vol. 1. Korte, F. Stuttgart; Thieme (1973). (In German).

A detailed treatment of the activation analytical investigation of organic material is presented. The physical principles of activation analysis are considered as well as the practical performance of activations by means of neutrons, photons, and charged particles. Other topics discussed include descriptions of irradiation procedures, sample preparations, chemical treatment of irradiated material and finally the activity measurement of the elements to be determined. Moreover, a great number of references are given to be the fundamentals of activation analysis and to the applications, such as the analysis of petroleum and petroleum products, different oils and greases, polymers, pharmaceuticals, food and biological materials. (GE)

26968 NONDESTRUCTIVE NEUTRON ACTIVATION DETERMINATION OF URANIUM BY THE 106 keV γ-PEAK OF NEPTUNIUM-239. II. Effect of Rare Earth Elements. Kuleff, I.; Todorovsky, D. (Sofia Univ.). Z. Anal. Chem.; 266: No. 1, 23-28(1973).

The interfering effect of the γ radiation of radioactive isotopes of the rare earths on the nondestructive neutron activation analysis of μg amounts of uranium, using the 106 keV-γ-line of ^{239}Np and NaI(Tl) detector, is estimated. The errors introduced by the interfering isotope in the analysis of uranium, are determined as a function of the ratio of the concentration in the sample of the interfering element and uranium. In addition, the possibilities of determining the quantitative effect of these elements are described. The use of the proposed method is demonstrated by the analysis of some geological samples. (auth)

26969 ROLE OF THE U. S. TREASURY DEPARTMENT IN THE USE OF FORENSIC SCIENCE IN LAW ENFORCEMENT. Golding, E. I. (Dept. of the Treasury, Washington, DC). J. Ass. Offic. Anal. Chem.; 56: No. 5, 1191-1198(Sep 1973).

Newer techniques in use by the Treasury department are reviewed including neutron activation analysis, atomic absorption spectroscopy, gas-liquid chromatography, spark-source mass spectroscopy, and laser and thin-layer chromatography. Future requirements for forensic science are also considered. (DHM)

26970 METHOD OF DETERMINING THE PRESENCE AND AMOUNT OF VANADIUM IN AN EARTH FORMATION. Kramer, H. H.; Thompson, S.; Cosolito, F. J. (to Union Carbide Corp.). US Patent 3,746,871. 17 Jul 1973. Filed date 2 Dec 1970. 4p.

A method is provided for determining the vanadium content of an ore formation employing neutron activation of the ore formation from within a borehole. (auth)

26971 NEUTRON-ACTIVATION DETERMINATION OF VANADIUM IN SILICATE MATERIALS. Decarreau, A.; Jaffrezic, H. (Univ., Paris, Essonne, France). Compt. Rend., Ser. D; 274: No. 18, 2553-2555(1972). (In French).

The rock sample, previously heated to 800°C is treated with $HF-HNO_3$. The mixture is heated to dryness, the residue is dissolved in $HNO_3-H_2O_2$, and the solution is heated to dryness. The residue is treated with HNO_3 (12 ml) and the clear solution

is decanted off; this treatment is repeated twice with 4 ml of HNO_3 and the solution is made up to 20 ml. The V is separated from major elements by paper chromatography. The portions of paper containing the V and a V standard are irradiated in a flux of $\simeq 7 \times 10^{12}$ n/cm^2 · sec for 30 sec. and subjected to γ-spectrometry with a Ge(Li) detector. For very low counts several chromatographic spots from the same sample are irradiated together. The limit of detection is 3 to 5 μg per g. Clays, marls and international standard samples were analysed by this method. The high sensitivity of the method permits studies of the distribution of V in the various phases of sedimentary rocks. (Anal. Abstr.)

26972 ACTIVATION ANALYSIS FOR TRACES OF TANTALUM IN CERIUM. Rouchaud, J. C.; Revel, G. (CEA, Val-de Marne, France). Compt. Rend., Ser. C; 274: No. 25, 2063-2065(1972). (In French).

Samples, together with Ta standards, are sealed in silica ampoules under a pressure of 0.001 torr and irradiated in a neutron flux of $\simeq 3 \times 10^{12}$ n/cm^2 · sec for 7 days. Each sample is then dissolved in 0.3M−HNO_3−0.5M-tartaric acid and the solution is passed through a column (1 cm diam.) of Dowex 50-X8. The resin is washed with 0.5M-tartaric acid (80 ml) to elute Ta, accompanied by Zr, Th and Hf; all the Ce is retained on the resin. After extraction with isobutyl methyl ketone, the radioactivity due to Ta is measured with a γ-spectrometer fitted with a NaI(Tl) detector. The limit of detection is 0.2 ng of Ta. (Anal. Abstr.)

26973 DETERMINATION OF ZINC AND NICKEL BY CHARGED PARTICLE ACTIVATION ANALYSIS. Swindle, D. L.; Schweikert, E. A. (Texas A and M Univ., College Station). Anal. Chem.; 45: No. 12, 2111-2115(Oct 1973).

Procedures for the sub-ppM determination of zinc and nickel were developed using charged particle activation analysis. Reactions with protons, deuterons, ^{3}He, and ^{4}He beams on thick Zn and Ni targets were investigated. The most favorable reactions for Zn and Ni analysis were the ^{66}Zn(p,n)^{66}Ga and the ^{58}Ni(p,pn)^{57}Ni reactions, respectively. A series of samples was analyzed with zinc or nickel contents ranging from 500 to less than 1 ppM, utilizing a post-irradiation chemical separation of the product nuclides. Results from thick target experiments indicate that both Zn and Ni determinations can be made at the ppB level. Activation curves (relative excitation functions) for the reactions used for analysis, as well as possible interfering reactions, are presented and discussed. (auth)

26974 USE OF THE NUCLEAR REACTION ^{16}O(d,α)^{14}N IN THE MICROANALYSIS OF OXIDE SURFACE LAYERS. Turos, A.; Wielunski, L.; Barcz, A. (Inst. of Nuclear Research, Warsaw). Nucl. Instrum. Methods; 111: No. 3, 605-610(1973).

The nuclear reaction ^{16}O(d,α)^{14}N induced by 900 keV deuteron bombardment has been used in concentration profile measurements of oxygen in oxide surface layers. The concentration profile can be deduced from the shape of experimental energy spectra of α-particles. The method has been applied in investigations of silicon oxide layers thermally grown on silicon of thicknesses from 2000 Å up to 12,000 Å. The influence of energy straggling, energy resolution, and experimental geometry on the depth resolution is discussed. (auth)

26975 METHOD FOR SIMULTANEOUS DETERMINATION OF CARBON AND OXYGEN ON THE SURFACE OF METALS BY THE (t,p) REACTION AT LOW ENERGIES. Barrandon, J. N. (CEN de Saclay, Gif sur Yvette, France); Seltz, R. Nucl. Instrum. Methods; 111: No. 3, 595-603(1973). (In French).

A method is described for microanalysis of oxygen and carbon on the surface of metal samples by the detection of protons from the (t,p) reaction at bombarding energies below 2 MeV. Possible sources of inaccuracies are discussed and an experimental procedure is given for simultaneous analysis of oxygen and carbon surface layers with a sensitivity of 5×10^{-2} μg/cm^2. The influence of possible contamination by residual vapor pressures during exposure is studied. (auth)

26976 INSTRUMENTAL ACTIVATION ANALYSIS OF LUNAR SAMPLES. Rosenberg, R. J. (Technical Research Centre, Otaniemi, Finland). Acta Chem. Fenn.; 45: No. 12, 399-404 (1972).

By varying the irradiation time, cooling time and counting time and by use of small and large Ge(Li) detectors it was possible to determine 30 elements. The USGS rocks W-1 and G-1 were used as standards except for the lanthanoids, Ta, Th, and U, standards for which were prepared from the oxides or (for Ta) from the metal. Results for seven samples from the Apollo 14 mission and one from the Apollo 15 mission are given. The accuracy is discussed and compared with that obtained by other authors. (Anal. Abstr.)

26977 STUDY OF THE COMPOSITION OF TEETH AND SALIVA BY NEUTRON ACTIVATION ANALYSIS. Ryabukhin, Yu. S.; Maksimovskii, Yu. M.; Barer, G. M. (Inst. of Radiological Medicine, Moscow). Stomatologiya; 51: 62-64(1972). (In Russian).

The advantages and principles of activation analysis, principally with thermal neutrons, and the elements found in teeth and saliva by this method are discussed (23 references). (TTT)

26978 DETERMINATION OF VANADIUM AND SODIUM IN FUEL OIL. Gibbons, D. (Atomic Energy Research Establishment, Harwell, Eng.); Metcalfe, B.; Rosborough, D. F. J. Inst. Petrol.; 59: No. 566, 84-90(Mar 1973).

The progressive increase of inlet temperatures in the development of more efficient gas turbines is requiring manufacturers to impose stricter fuel specifications. In particular, the maximum concentrations proposed for vanadium are now often below the precision limits of established spectrophotometric methods. Reactor-based neutron activation analysis, using high resolution Ge(Li) γ ray spectrometry, provides a sensitive instrumental method for the simultaneous measurement of vanadium and sodium. The practical limit of determination for vanadium varies from about 0.002 ppM for distillate oils to about 0.02 ppM for crude oils, the sensitivity limit being determined primarily by the concentrations of other trace elements in the oil. For simultaneous measurement of sodium, the limit varies similarly from about 1.0 to 10.0 ppM, but for separate measurement the potential limit is below 1 ppB. An analysis time of about one hour can be achieved using a sample weight of only 1 to 2 g, and the method should find particular application in monitoring fuels used in advanced gas turbines for marine propulsion and power generation. (auth)

26979 MEASUREMENT OF WHOLE-BODY NITROGEN BY NEUTRON-ACTIVATION ANALYSIS. Harvey, T. C.; Jain, S.; Dykes, P. W.; James, H.; Chen, N. S.; Chettle, D. R.; Ettinger, K. V.; Fremlin, J. H.; Thomas, B. J. (Univ. of Birmingham, Eng.). Lancet; 2: No. 7826, 395-399(25 Aug 1973).

Whole-body nitrogen was measured in man using neutron activation analysis. Patients were irradiated with a small dose of fast neutrons and the capture γ rays arising from neutron interactions with nitrogen nuclei were recorded. Sixty-five patients with various diseases have been studied on 190 occasions. The technique proved to be highly reproducible and its advantages in the study of metabolic disorders are discussed. (auth)

26980 ANALYSIS OF PRECISION OF ACTIVATION-ANALYSIS METHODS. Heydorn, K.; Noergaard, K. (Danish Atomic Energy Commission, Risoe). Talanta; 20: No. 9, 835-842(Sep 1973).

From international conference on modern trends in activation analysis; Paris, France (Oct 1972).

The precision of an activation analysis method prescribes the estimation of the precision of a single analytical result. The adequacy of these estimates to account for the observed variation between duplicate results from the analysis of different samples and materials is tested by the statistic T, which is shown to be approximated by a χ^2 distribution. Application of this test to the results of determinations of manganese in human serum by a method of established precision, led to the detection of airborne pollution of the serum during the sampling process. The subsequent improvement in sampling conditions was shown to give not only increased precision, but also improved accuracy of the results. (auth)

26981 DETERMINATION OF OXYGEN AND SILICON IN ROCKS BY 14-MeV NEUTRON-ACTIVATION ANALYSIS AND ITS PRECISION. Huysmans, K.; Gijbels, R.; Hoste, J. (Ghent Rijksuniversiteit). Talanta; 20: No. 9, 843-853(Sep 1973).

Oxygen and silicon were determined in the six new U. S. Geological Survey standard rocks and two standard refractory materials by 14-MeV neutron-activation analysis, followed by both single and multichannel analyzer counting of the induced ^{16}N (4.5 to 8 MeV gamma radiation) and ^{28}Al activities (1.78 MeV photopeak). Owing to the long analyzing time per pulse, dead-time corrections are necessary in multichannel analyzer counting. Four methods were investigated: counting in the live-time mode without additional correction, short counting corrected by an external live-time scaler, the method of Bartosek (Nucl. Instr. Methods; 103: 45 (1972)), and the method of Schonfeld (Nucl. Instr. Methods; 42: 213 (1966)). Each measurement was controlled by a simultaneous measurement with a single-channel analyzer. Silica ignited at 1000°C was used as a reference. Correction was made for the interfering elements, F, P, Al, Fe, and Mg, using literature data. Attention was paid to neutron, gamma, and beta attenuation. For oxygen the mean coefficient of variation for a single determination with a single-channel analyzer was 1.7%, for silicon 1.1%. The mean results for single-channel counting were compared with literature values. (auth)

26982 RADIOACTIVATION DETERMINATION OF PLATINUM USING ITS SUBSTOICHIOMETRIC SEPARATION. Rakovskii, E. E.; Krylova, T. D.; Starozhitskaya, M. I.; Frolova, A. Yu. (Central Scientific-Research Mining and Prospecting Inst. of Nonferrous, Rare, and Noble Metals, Moscow). Zh. Anal. Khim.; 28: No. 8, 1554-1556(Aug 1973). (In Russian).

The solvent extraction of platinum dithizonate was studied as a function of the aqueous phase acidity, reagent concentration, and time of agitation. Optimal conditions for the platinum dithizonate formation were found. A method was developed for the neutron activation determination of platinum with the use of its substoichiometric separation. (auth)

26983 THIN-LAYER CHROMATOGRAPHY OF NOBLE METALS. Communication 7. The Radioactivation Determination of Iridium in Zones in the Analysis of Sulphate Solutions. Volynets, M. P.; Dubrova, T. V.; Ermakov, A. N.; Kuligin, V. M.; Rakovskii, E. E. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 8, 1557-1560(Aug 1973). (In Russian).

Thin-layer chromatography was used for the separation of sulfate complexes of Pt, Pd, and Ir. The chemical yield of Ir into the main zone is about 70%, Pt and Pd being completely separated. The absolute content of Ir in a zone on the chromatogram (within 0.01 and 0.1 mg) can be determined by the radioactivation method with a relative error of ± 20%. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 27143, 27220, 29473–29477, 29508, 29513, and 29536.

26984 (AERE-R-6962) DETERMINATION OF OXYGEN–METAL RATIOS IN URANIUM AND URANIUM–PLUTONIUM DIOXIDES. Jones, I. G. (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 65p. Dep. NTIS (U. S. Sales Only) $5.25. UK £ 1.50.

The gas equilibration method (Markin, et al., A.E.R.E.–R4608 (1964)), for the determination of oxygen/metal ratios, was developed and applied to a variety of oxides of uranium and plutonium. A description of the uranium and uranium/plutonium oxide system from an analytical viewpoint is given, and a short review of methods for the determination of oxygen content is included. The gas equilibration method is discussed and the apparatus used is described fully. Interferences were investigated and the appropriate corrections applied, in particular for carbon impurity. The precision of the method is ±0.0005 atoms oxygen (1 σ), using a 200 mg sample. Smaller sample weights down to 30 mg may be employed, but with a loss of precision. A value for the carbon content can be obtained from the analysis and also some quantitative information on the nitrogen and hydrogen contents of the sample. The method was also applied to uranium dioxide taken from coated particle fuel. (auth)

26985 (BARC/I-187, pp 7) SETTING UP OF TECHTRON AA-4 AS FLAME EMISSION ATOMIC ABSORPTION AND FLUORESCENCE SPECTROMETER. Murugaiyan, P.; Natrajan, S.; Venkateswarlu, C. (Bhabha Atomic Research Centre, Bombay). 1972.

The Analytical Chemistry Division, Bhabha Atomic Research Center, Bombay has purchased a Techtron AA-4 from M/s. Varian Techtron, Australia, excluding the hollow cathode lamps and the power supply, with the intention of using the electrodeless discharge tubes prepared in the Divisional Laboratory as light sources. The setting up of the Techtron AA-4, along with the other equipment, and its use in the three modes of flame methods of analysis, viz. flame emission, atomic absorption and fluorescence, are described. The sensitivities for Cd, Co, Tl, and Zn electrodeless discharge tubes prepared in the Divisional Laboratory were found to be comparable to those obtained, using commercially available hollow cathode lamps. Analytical methods for the determination of ppM amounts of calcium in UO_2 pellets by flame emission, cadmium in indium compounds by atomic absorption and submicrogram amounts of cadmium in uranium compounds by atomic fluorescence are explained. (INIS)

26986 (BNWL-1751(Pt.2), pp 63-64) ATOMIC ABSORPTION IN ENVIRONMENTAL TRACE ELEMENT ANALYSIS. Langford, J. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The atomic absorption research capability has been improved with the addition of a graphite furnace system permitting detection of many elements in the 1 ng concentration range. Indium is measured on filter paper air samples. Matrix problems are still present, but they can be circumvented by using the infinite dilution technique. Copper is easily measured in marine organisms as is cadmium. Due to spectral interferences at the extremely low concentration desired, accurate measurement of lead is not possible. Separation procedures were developed which proved useful in the measurement of Hg in biological samples. Mercury is separated from biological samples by burning the samples in an O_2 stream and absorbing it onto Ag powder. The Ag powder is then heated to release the Hg into an absorption cell for measurement by the atomic absorption technique. Stable lead is measured in certain samples allowing the specific activity of ^{210}Pb to be calculated. (DHM)

26987 (BNWL-SA-4690) REVIEW OF A WORKSHOP ON X-RAY FLUORESCENCE ANALYSIS OF AEROSOLS, SEATTLE, WASHINGTON, APRIL 4–6, 1973. (Battelle Pacific Northwest Labs., Richland, Wash.). 1 Jun 1973. 31p. Dep. NTIS $3.75.

Aerosol sampling techniques, methods of x-ray excitation and analysis, quantitative procedures, and other independent methods of analysis were discussed. It was generally agreed that of the energy-dispersive x-ray fluorescence techniques, mono-energetic photon and proton excitation offer the best detectabilities. Proton excitation appears to offer greater sensitivity for the analysis of small quantities of material on thin backings while photon excitation appears more versatile and applicable to thicker samples. Wavelength-dispersive x-ray fluorescence seemed to have better detectability for low atomic-number elements and is generally applicable to aerosol analysis. It was also generally accepted that x-ray fluorescence analysis has demonstrated an ability to provide definitive quantitative analysis for up to 18 elements in urban aerosols (Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Br, Sr, Zr, Mo, Cd, Sn, Ba and Pb) and semiquantitative analysis for up to 9 low atomic-number elements (Na, Mg, Al, Si, P, S, Cl, K and Ca). Membrane filters were generally preferred for x-ray fluorescence analysis. Standards and correction factors used are adequate for most elements but must be established for elements below Ti. Current computer programs are adequate for the more abundant elements, but further work is required for effective analysis of low intensity and complex peaks. The publication of additional quantitative results and quantitative intercomparison studies would greatly advance the general acceptance of x-ray fluorescence as a quantitative tool for aerosol analysis. (auth)

26988 (NIM-1534) DETERMINATION, BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY, OF NOBLE METALS IN THE PRESENCE OF SODIUM, BARIUM, OR SULPHATE IONS. A Comparison of Uranium and Lanthanum as Releasing Agents. Mallett, R. C.; Dubois, M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 10 May 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The effect of lanthanum in 10% (v/v) hydrochloric acid and uranium in 40% (v/v) hydrochloric acid on the interferences caused by sodium, barium, and sulfate ions is compared. When sodium chloride or barium chloride was present, there was no significant difference in "recovery" (i.e., the percentage of added noble metal that was determined) for all the noble metals whether uranium or lanthanum was used as the releasing agent. The notable exception was in the determination of iridium when lanthanum was used, a significant enhancement being noted. For platinum, recoveries were slightly better with lanthanum than with uranium at high sodium chloride concentrations. Interference from sulfate ions was marked in the determination of platinum, rhodium, ruthenium, and iridium, when uranium was used, and almost completely absent when lanthanum was used in the determination of platinum and rhodium. (auth)

26989 (ORO-2124-25) PROPERTIES AND STRUCTURES OF SOLVATES OF METAL CHELATES ENCOUNTERED IN SOLVENT EXTRACTION SYSTEMS. Wagner, W. F.; Sands, D. E. (Kentucky Univ., Lexington. Dept. of Chemistry). 14 Aug 1973. Contract AT(40-1)-2124. 8p. Dep. NTIS $3.00.

Research progress is reported in four principal areas: Countercurrent extraction of rare earth β diketonates; spectrographic analysis of rare earths; properties of solvates of rare-earth β-diketonates; and crystal and molecular structures of rare-earth β-diketonates. (auth)

26990 (RDT-F-2-6-T(7-73)) QUALIFICATION AND CONTROL OF ANALYTICAL CHEMISTRY LABORATORIES FOR MIXED OXIDE FUEL ANALYSIS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 23p. RSO.

A standard is presented that prescribes the course of action for qualification of the technical competence of analytical chemistry laboratories to do the chemical analyses required for the

acceptance of fuel material which include uranium dioxide powder and pellets, plutonium dioxide powder, mixed oxide powder and pellets, plutonium nitrate solution, and uranyl nitrate solution. It also provides a quality control program for the continual evaluation of the analytical data obtained during periods of fuel production. (auth)

26991 (RDT-F-11-1-T(7-73)) ANALYTICAL CHEMISTRY METHODS FOR MIXED OXIDE FUEL. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 110p. RSO.

A standard is presented that contains methods of analysis of materials used to produce mixed oxide fuels. The materials are ceramic fuel and insulator pellets and the plutonium and uranium oxides and nitrates used to fabricate the pellets. Methods are given for determining plutonium, uranium, oxygen-to-metal ratios, plutonium, and uranium isotopic composition, fluoride, chloride, nitrogen as nitride, tungsten, sulfur, phosphorus, uranium impurities in plutonium dioxide, metallic impurities, rare earths, carbon, water, gas content, total volatiles, free acid, undissolved solids, entrained organics, surface areas, and ^{241}Am. (DHM)

26992 (RDT-F-11-2-T(7-73)) ANALYTICAL CHEMISTRY METHODS FOR BORON CARBIDE ABSORBER MATERIAL. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 67p. RSO.

A standard is presented for the chemical analysis of boron carbide pellets. Methods included are: total carbon by combustion method, total boron by titration method, boron isotopic ratio by thermal ionization mass spectroscopy, soluble carbon by conversion to CO_2 and measuring manometrically, soluble boron by extraction–titration method; fluorine by fluoride-selective electrode method; chlorine by coulometric method; impurities by spectrographic method; method for gas content, and method for water. (DHM)

26993 DETERMINATION OF STRONTIUM IN SILICATE ROCKS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Ronco, A. E.; Merodio, J. C. (Univ., National, La Plata). An. Asoc. Quim. Argent.; 60: No. 6, 475-487(1972). (In Spanish).

The sample is decomposed with $HF-HClO_4$ at <250°C, the solution is evaporated to dryness, and a solution of the residue in HCl (1 : 1) is diluted with H_2O to contain ≃1 μg of Sr per ml. The Sr is determined by its atomic absorption at 460.7 nm (N_2O–acetylene flame). The method of additions is used in conjunction with reference graphs prepared with standards containing added Na, which is present in the rock samples. Reproducible results in agreement with those by other methods are reported for various rocks and simulated samples. (Anal. Abstr.)

26994 NIOBIUM IN STEELS: SPECTROCHEMICAL ANALYSIS. Kasinathan, S.; Ramamoorthy, D. (Bharat Heavy Electricals Ltd., Tiruchirapalli, India). Met. Metal Form.; 40: No. 1, 25-26(1973).

The method developed for the determination of 0.02 to 0.05% of Nb involves point-to-plane spark excitation of the sample, with use of a graphite counter-electrode. The line pair Nb 3130.8 Å–Fe 3125.65 Å is used. Arc excitation is unsuitable because there is interference by Mn and Fe in the region of the most intense Nb lines. Results on 5 samples containing ≃0.02 to 0.04% of Nb show standard deviations of <0.0021% (5 determinations at widely spaced intervals of time). (Anal. Abstr.)

26995 ANALYTICAL APPLICATION OF HIGH FREQUENCY, PHASE SENSITIVE SHORT CONTROLLED DROP TIME ALTERNATING CURRENT POLAROGRAPHY. Bond, A. M. (Univ. of Melbourne, Parkville, Australia). Anal. Chem.; 45: No. 12, 2026-2031(Oct 1973).

In general, polarographic methods do not have the specificity for the interference free direct determination of elements in complex mixtures nor are they often sufficiently rapid to be competitive with other techniques. A description is given of the analytical use of rapid, short controlled drop time, high frequency, 3-electrode, phase-sensitive ac polarography. The use of high frequencies (500 to 1000 Hz) instead of the usually recommended low frequencies (10 to 100 Hz) can provide considerable discrimination against unwanted electrode processes. The medium for dissolution of many samples prior to their determination is often acidic, and in such media, and with the technique proposed, removal of oxygen is often unnecessary. This plus the use of short controlled drop times and fast scan rates of potential provide a route to an attractive method of analysis having a time scale close to that for atomic absorption spectrometry, linear calibration curves over several orders of magnitude of concentration, ready checks on interference, and other useful features. The determination of tin and a comparison of results with those obtained independently by several other laboratories using atomic absorption spectrophotometry, x-ray fluorescence, and colorimetric methods are given, to demonstrate the usefulness of the method. Other examples are also given including the determinations of U, Pb, and Cu. (auth)

26996 DEVICE FOR DIRECT MEASUREMENT OF THE CURVE OF CONCENTRATION OF AN ELEMENT IN A MATERIAL. Blanchard, B.; Hilleret, N.; Monnier, J.; Quoirin, J. B. (to Commissariat a l'Energie Atomique). US Patent 3,757,116. 4 Sep 1973. Priority date 22 Feb 1971, France. 6p.

A method is described for direct measurement of the curve of concentration of an element in a material. The material is subjected to bombardment by a beam of primary ions, and the material in turn emits a beam of secondary ions. The next step consists of recording simultaneously the total current corresponding to all the ions contained in the secondary beam and the ratio of the current that corresponds solely to the ions of the element contained in the beam, to the total current. (Official Gazette)

26997 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM IN TITANIUM–MOLYBDENUM ALLOYS. Merkulova, K. S.; Bruile, E. S. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 3, 690-691(Mar 1973).

Translated from Zh. Prikl. Khim.; 46: No. 3, 655-656(Mar 1973).

A method was developed for the spectrophotometric determination of cerium in titanium alloys containing 28 to 30% molybdenum. The method consists of precipitating as oxalate, dissolving in boric acid–citrate solution, and measuring the optical density at λ = 380 mμ. The error of the determination does not exceed −11.1%. (DHM)

26998 TERNARY COMPLEXES OF RARE EARTH ELEMENTS WITH GLYCINETHYMOL BLUE AND CETYLTRIMETHYLAMMONIUM BROMIDE. Kirillov, A. I.; Makarenko, O. P.; Poluektov, N. S.; Lauer, R. S.; Shaulina, L. P. (Irkutsk State Univ., USSR). Zh. Anal. Khim.; 28: No. 8, 1618-1621(Aug 1973). (In Russian).

The interaction of rare earths with glycinethymol blue and cetyltrimethylammonium bromide was studied. The yttrium subgroup elements react with the reagents in more acidic medium than the cerium subgroup elements. The highest optical density of solutions of the ternary complexes was observed at 646 nm and pH 8.0 and 9.0 to 9.5 for elements of the yttrium and cerium subgroup respectively. The ratio of Me : GTB : CTA = 1 : 2 : 4 was found. A method was developed for determining ytterbium in a mixture with lanthanum. The sensitivity is 1 to 2% for an yttrium subgroup element in a mixture with cerium subgroup elements. The error is 3%. (auth)

26999 FLUORIMETRIC DETERMINATION OF TERBIUM AS A COMPLEX WITH SALICYLIC AND ETHYLENEDIAMINETETRAACETIC ACIDS. Poluektov, N. S.; Alakaeva, L. A.; Tishchenko, M. A. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 8, 1618-1623(Aug 1973). (In Russian).

Optimal conditions were found for a fluorescence reaction of terbium with ethylenediaminetetraacetic acid and sodium salicylate. A complex compound with the ratio of Tb : EDTA : Sal = 1 : 1 : 1 is formed. The sensitivity of the method is 4.7×10^{-9} M Tb^{3+}. The coefficient of variation is 1.08 to 2.08. (auth)

27000 CATALYTIC ACTION OF RUTHENIUM AND OSMIUM IN THE REACTION OF THE REDUCTION OF SILVER (I) WITH IRON (II). Pilipenko, A. T.; Markova, L. V.; Maksimenko, T. S. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Anal. Khim.; 28: No. 8, 1544-1549(Aug 1973). (In Russian).

The reduction of silver (I) with iron (II) is catalyzed by colloidal ruthenium and osmium. This reaction has been used for developing kinetic methods for the determination of ruthenium and osmium. Their concentration is determined by the amount of the silver sol formed in the reaction of the reduction of silver (I) with iron (II). The sensitivity of the determination of Ru and Os is 5×10^{-4} μg/7 ml. The determination duration is about 1.5 h. (auth)

27001 CHEMICAL–SPECTRAL DETERMINATION OF MICROIMPURITIES IN ZINC COMPOUNDS. Bykova, I. N.; Manova, T. G.; Silakova, V. G.; Boznyakova, G. P. (All-Union Scientific Research Inst. of Chemical Reagents and Substances of High Purity, Moscow.) Zh. Anal. Khim.; 28: No. 8, 1481-1484 (Aug 1973). (In Russian).

A chemical-spectral method was developed for determination of 14 microimpurities (V, Bi, Fe, In, Cu, Ni, Pb, Ag, Co, Sn, Ti, Au, Cr, Mo) in different zinc compounds (zinc nitrate, carbonate, chloride, and oxide). The sensitivity is 5.10^{-7} to 5.10^{-6} % for most of the elements. The method can be used for determining from 5.10^{-7} to 5.10^{-4} % of the microimpurities. The coefficient of variation for most of the elements is 25 to 30%. (auth)

27002 SPECTROPHOTOMETRIC STUDY OF THE INTERACTION OF ZIRCONIUM WITH CERTAIN PHTHALEXONES. Communication 1. The Interaction of Zirconium with Phthalexone S, o-bromophthalexone S, and m-Cresolphthalexone SA. Cherkesov, A. I.; Zadumina, E. A.; Arzamastseva, S. F. (Saratov State Pedagogic Inst., USSR). Zh. Anal. Khim.; 28: No. 8, 1513-1518 (Aug 1973). (In Russian).

The complex formation of zirconium with phthalexone S, bromophthalexone S, and m-cresolphthalexone SA was studied spectrophotometrically. Optimal conditions for the complex formation were found. Stoichiometric coefficients and the number of hydrogen ions displaced during the complex formation were found. The 1:1 complexes are mainly formed. Molar extinction coefficients for the reagents and their complexes with zirconium and conventional stability constants were calculated. A suggestion is given on the chemistry of the formation reaction of zirconium complexes with phthalexones. Tolerable amounts of foreign ions were estimated. The photometric determination of zirconium in copper alloys was carried out. Best results were obtained in case of phthalexone S. (auth)

27003 DETERMINATION OF MICROAMOUNTS OF RUBIDIUM AND CESIUM IN THE PRESENCE OF EACH OTHER USING SUBSTOICHIOMETRIC SEPARATION. Spitsyn, V. I.; Zimakov, I. E.; Atrashkevich, V. V. (Inst. of Physical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 8, 1465-1470(Aug 1973). (In Russian).

Conditions for the extraction-substoichiometric separation of a mixture of rubidium and cesium tetraphenylborates into benzene using the ratio of extraction constants for $Cs[B(C_6H_5)_4]$ and $Rb[B(C_6H_5)_4]$ were determined. A relationship was found experimentally between the values of molar rubidium and cesium concentrations and the experimental values of the counting intensities of the samples from the organic extracts. Rubidium and cesium (microamounts) were determined in the presence of each other and without preliminary separation from model solutions with different molar concentrations of the elements if the concentration of one of them is known. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 27237, 27244, 27332, 27410–27417, 27421, 27422, 27700, 27927, and 29511.

27004 (BNWL-1751(Pt. 2), pp 32-33) ANALYTICAL PROCEDURE FOR MEASURING ^{218}Po, ^{214}Pb, AND ^{214}Bi IN RAIN SAMPLES USING Ge(Li) DIODES. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Polonium-218 and ^{214}Bi are removed from rainwater by anion exchange and ^{214}Pb is removed by cation exchange. The decay scheme of ^{222}Rn along with the in-cloud scavenging times strongly indicated that ^{218}Po present in rain must be associated with below-cloud scavenging, therefore, sampling times must be very short and filtering very rapid to minimize the loss of ^{218}Po due to decay. Measurements for ^{218}Po are made on the anion resin using a Ge(Li) diode by following the ingrowth of ^{214}Pb activity. Bismuth-214 measurements are also made on the anion resin and due to its relatively high concentration, the contribution from the decay of ^{218}Po was insignificant. Lead-214 concentrations were made on the cation resin. The data obtained from these initial results indicate that the procedure can be used to measure ^{218}Po, ^{214}Pb, and ^{214}Bi in rain and that the concentration of ^{218}Po in rain is near the detection level for the size samples collected. (DHM)

27005 (BNWL-1751(Pt. 2), pp 49-50) SEPARATION OF STABLE AND RADIOIRON FROM SEAWATER BY SCAVENGING WITH MANGANESE DIOXIDE. Langford, J. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A method was developed for determining stable iron and ^{55}Fe in large volumes of seawater which involves coprecipitation with MnO_2 from a basic solution. The MnO_2 and occluded ferric hydroxide precipitate were separated by decantation and filtration. The precipitate was dissolved in concentrated HCl and the iron was separated from Mn by passing the solution through a Dowex 2-X8 chloride form column. The iron was eluted with HCl and extracted with alamine, back extracted into $HClO_4$, and precipitated with NH_4OH. The precipitate was then dissolved in H_2SO_4 and saturated $(NH_4)_2C_2O_4$ and the iron was electroplated for 2 h onto a copper disc. The ^{55}Fe measurements were made using a thin window gas-flow proportional counter. The stable iron was measured colorimetrically before plating by developing it with orthophenanthroline. (DHM)

27006 (BNWL-1751(Pt. 2), pp 50) DETERMINATION OF ^{55}Fe IN SEDIMENT SAMPLES. Langford, J. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A hydrochloric acid leaching technique was developed to measure ^{55}Fe in sediment samples from the Columbia River. Iron is leached from 1 to 2 g of sediment by refluxing in 6 N HCl for 2 hours. Under these conditions, greater than 96% of the Fe is removed. The iron from 25 ml aliquot was extracted with alamine, back extracted into 1 M $HClO_4$ and precipitated with NH_4OH. The filtered ferric hydroxide was dissolved in 6 N H_2SO_4 and saturated ammonium oxalate and electroplated for 2 hours onto a copper disc. The copper disc was dried, weighed and counted on a thin window gas-flow proportional counter. (DHM)

27007 (BNWL-1751(Pt. 2), pp 55-56) DIRECT INSTRUMENTAL MEASUREMENT OF THORIUM, URANIUM, AND POTASSIUM IN COAL AND FLYASH. Rancitelli, L. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The coal and flyash standard samples prepared by the National Bureau of Standards were analyzed for their U, Th, and K content by using a multi-dimensional γ ray spectrometer. A homogenized sample weighing 75 g was counted in a standard geometry; the observed activities resulting from $^{232}Th(^{208}Tl)$, $^{235}U(^{214}Bi)$, and $K(^{40}K)$ were compared with the standards prepared from Al_2O_3 which contained precisely known amounts of these elements. The NBS coal sample was found to contain 0.28 ± 0.01% K, 3.45 ± 0.016 ppM Th, and 1.41 ± 0.05 ppM U; the flyash contained 1.71 ± 0.03% K, 26.2 ± 0.7 ppM Th, and 12.0 ± 0.3 ppM U. (DHM)

27008 (BNWL-1751(Pt. 2), pp 57-61) COMPARISON OF PARTICLE AND PHOTO-EXCITED X-RAY FLUORESCENCE APPLIED TO TRACE ELEMENT MEASUREMENTS OF ENVIRONMENTAL SAMPLES. Cooper, J. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Samples of orchard leaf, bovine liver, aerosols, sea salts, and geological material were analyzed by x-ray fluorescence using excitation sources of 80 and 40 MeV alpha particles, 4 and 2 MeV protons, Mo transmission tube, and radioisotopic x rays. Results suggest that photon excitation is a more practical tool than particle excitation for general trace element studies of environmental samples by energy-dispersive x-ray fluorescence analysis. (DHM)

27009 (BNWL-1751(Pt. 2), pp 62) RAPID MULTIELEMENT ANALYSIS OF AEROSOLS WITH X-RAY FLUORESCENCE USING HIGH-INTENSITY RADIOISOTOPIC SOURCES. Cooper, J. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The aerosol samples are mounted in 35 mm slide frames and positioned around the exposure wheel where they are automatically and sequentially positioned above the radioisotopic excitation source and detector and are analyzed under computer control. Standards containing known amounts of an element (nominally 40 $\mu g/cm^2$) are also analyzed and their K X-ray peak areas compared to those obtained with unknown aerosol samples. This quantitative technique was applied to the analysis of elements with atomic numbers greater than Cr in aerosols collected on Whatman 41 and nucleopore filters and on mylar impaction surfaces. The ^{109}Cd source provides sufficient X-ray excitation intensity to rapidly and simultaneously detect S, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, Sr, Mo and Pb on urban air filters in as little as 30 minutes. Sensitivities in the order of several ng/m^3 of air have been achieved where volumes of 3 m^3 of air per cm^2 of filter are sampled. (DHM)

27010 (BNWL-1751(Pt. 2), pp 65-66) CONTAMINATION FREE MARINE AIR SAMPLING EQUIPMENT FOR MEASURING ^{55}Fe, RADIONUCLIDES, AND TRACE ELEMENTS. Jenkins, C. E.; Rieck, H. G. Jr. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The equipment developed for use in the sampling program consists of an air filtering apparatus mounted on a 20-foot telescoping tower positioned on the bow of a ship. The air sampling apparatus consists of a stainless steel head which has two 12-inch diameter air filter screens. This head is positioned on an aluminum stand which is covered with a circular cylinder extending one

foot below the sampling head with an opening at the bottom to allow air passage. To minimize contamination, the entire air sampling apparatus is painted with a clear organic lacquer. Air flow is provided by a 240 cfm Roots RAI-55 blower which is powered by a 7.5 hp electric motor mounted on the ship's deck. The blower is connected to the tower by a flexible 4-inch diameter high vacuum suction hose allowing the tower to be raised or lowered. (DHM)

27011 (BNWL-1751(Pt. 2), pp 66-67) SEQUENTIAL PROCEDURE FOR MEASURING ^{239}Pu, ^{238}Pu, ^{241}Am, ^{90}Sr, AND ^{55}Fe IN AIR SAMPLES. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A method was developed for the sequential removal of Am, Pu, Sr, and Fe from a large membrane filter. After fusion and dissolution the strontium is removed by precipitation as strontium nitrate and determined by a standard radiochemical method. The filtrate is passed through a Dowex 1-X8 Cl^- form column which retains the Pu. The Pu is eluted from the column with HCl containing HI, electrodeposited, and alpha counted. The filtrate containing Am and Fe is passed through an ion exchange column (Dowex 50-X8 H^+ form) and the Am is retained on the column. The filtrate is analyzed for ^{55}Fe by standard radiochemical methods. The Am is eluted from the column with 7 M HCl and analyzed using standard radiochemical methods. (DHM)

27012 (BNWL-1751(Pt. 2), pp 68) DETERMINATION OF LOW-LEVEL ^{210}Po IN REAGENTS AND GLASSWARE. Langford, J. C.; Brodzinski, R. L. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

An Ortec partially depleted silicon surface-barrier diode (450 mm^2 with a 350 μ depletion layer) was coupled to a low-noise Ortec 125S preamplifier. The background in the ^{210}Po region of the alpha energy spectrum was 0.0001 c/min with an absolute counting efficiency of 0.31 for ^{210}Po. Silver discs were used for the spontaneous deposition of ^{210}Po from solution after cleaning and coating one side with spray enamel to avoid ^{210}Po deposition on both sides of the disc. Vycor, Pyrex, soft clear glass, and amber glass were checked for leachable ^{210}Po. Only Vycor was essentially free of ^{210}Po activity. All other glasses yielded leachable ^{210}Po at levels found to be proportional to the iron content of the glass. Six reagents commonly used in polonium separations were also checked for ^{210}Po contamination. Analytical results showed none contained sufficient activity in normally used quantities to affect most measurements. Polonium-210 concentrations measured in HNO_3, HCl, H_2SO_4 and H_2O_2 were about 3×10^{-6} dpm/g, which $HClO_4$ contained 1×10^{-5} dpm/g. Ascorbic acid had by far the highest ^{210}Po concentration of 0.6×10^{-4} dpm/g, however, only very small quantities of the reagent are normally required in ^{210}Po separation procedures. (DHM)

27013 (HASL-300(S-1)) HASL PROCEDURES MANUAL. Harley, J. H. (ed.) (Health and Safety Lab. (AEC), New York). 1972. 103p. Dep. NTIS $5.45.

Revision pages to the HASL procedure manual are presented. (DHM)

27014 (LUNP-7308) TRACE ANALYSIS OF SAMPLES OF LIQUIDS BY USING PROTON-INDUCED X-RAY FLUORESCENCE. Groenwall, J. (Lund Inst. of Tech. (Sweden)). Jun 1973. 49p. (In Swedish). Dep. NTIS (U.S. Sales Only) $4.50.

By using proton-induced x-ray emission spectroscopy in elemental trace analysis of liquids, a lower limit of detection about 0.1 ppM in a water solution can be reached. According to the method described, a few cm^3 of a liquid sample is in direct contact with a thin window of Kapton through which the proton beam is extracted. To detect the x-ray emission a high resolving Si(Li)-detector was used. (auth)

27015 (NIIAR-P-123) DETERMINATION OF THE GAMMA-EMITTING ISOTOPES CONCENTRATIONS IN EXTENDED SOURCES WITHOUT SAMPLING. Polyakov, V. I.; Chechetkin, Yu. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 28p. (In Russian). INIS.

A scintillation γ spectrometer with collimator was used for measuring without sampling the concentration of isotopes in a body or on the surface of sources of different configurations. The analytical expressions, as experimental verification indicate, permit the determination of the specific activity with an error of 10 to 15%. A method for the calibration of a spectrometer without collimator was described. (tr-auth)

27016 (NIM-1552) PREPARATION AND ANALYSIS OF MINERALS FOR USE AS REFERENCE MATERIAL. Progress Report No. 2. Stoch, H.; Summerson, C. D. (National Inst. for Metallurgy, Johannesburg (South Africa)). 18 Jun 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Progress is reported in the collection of the reference samples, the three interlaboratory analytical programmes (ferrochromium slags, rare earths, and fluorspar), and the preparation of "mixed" NIMROC samples, which have been used to determine the efficiency of x-ray-fluorescence analysis under routine conditions. Additional results for thorium, rare earths, tin, tantalum, and niobium for the appropriate reference samples are included in a revised table. (auth)

27017 CALIBRATION OF THE NATIONAL BUREAU OF STANDARDS' TRITIUM STANDARDS BY MICROCALORIMETRY AND GAS COUNTING. Mann, W. B. (National Bureau of Standards, Washington, DC). pp 86-102 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The methods used and problems involved in calibrating tritium standards are reviewed. (DHM)

27018 DETERMINATION OF TRITIUM IN AN ANALYTICAL CHEMISTRY LABORATORY. Genty, C.; Schott, R.; Lefevre, H.; Froment, G.; Sanson, C. (Centre d'Etudes de Bruyeres le-Chatel, Montrouge, France). pp 102-112 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The following analytical methods may be employed in the quantitative analysis of tritium: gas-phase chromatography, mass spectrometry, measurement in an ionization chamber, calorimetry, and liquid scintillation counting. These methods are briefly discussed and compared. (DHM)

27019 CHROMATOGRAPHIC SYSTEM FOR THE ENRICHMENT AND ANALYSIS OF LOW-LEVEL TRITIUM SAMPLES. Hayes, D. W.; Hoy, J. E. (E. I. du Pont de Nemours and Co., Aiken, SC). pp 127-132 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Automation and optimization of Hoy's methods [Sci. 121, 464 (1968)] for tritium enrichment by chromatography are discussed. The enrichment scheme is as follows: The water sample is reacted with magnesium chips at 650°C in an enclosed furnace. The hydrogen generated sorbs directly onto an evacuated palladium column at ambient temperature. Tritium exhibits the highest partial pressure over palladium and diffuses through the column faster than either deuterium or protium. The first gas evolved, the tritium-rich fraction, is detected by a pressure increase in an evacuated proportional counter attached to the exit end of the column. After the tritium fraction is collected, the proportional counter is filled with propane gas and counted with a pulse-height analyzer to verify purity and electronic gain. (DHM)

27020 LABORATORY SYSTEM FOR TRITIUM ANALYSIS OF LARGE NUMBERS OF ENVIRONMENTAL SAMPLES. Moden, D. D.; Mullins, J. W.; Jaquish, R. E. (National Environmental Research Center, Las Vegas, NV). pp 512-516 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Techniques are described for the collection and analysis of samples of surface waters, atmospheric moisture, urine, vegetation, soil, blood, animal tissue, and natural gas for tritium. Forty samples a day can be analyzed with an estimated minimum detectable activity of 400 pCi/l of water using liquid scintillation counting technique. (DHM)

27021 ANALYSIS FOR TRITIUM IN WATER: INTERCOMPARISON STUDY OF NOVEMBER 1970. Baratta, E. J. (Analytical Quality Control Service, Winchester, MA). pp 522-530 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The experiment by the laboratories consisted of triplicate analyses on one biological (urine) and three 1-liter distilled water samples containing known concentrations of tritium. Results show that precision was good and all analyses fell well within the upper warning level for all samples, indicating that the laboratories' reproducibility was good. (DHM)

27022 EQUIPMENT FOR THE DETERMINATION OF CONCENTRATIONS OF FISSIONABLE AND/OR FERTILE MATERIALS BY MEANS OF X-RAY FLUORESCENCE SPECTROMETRY. von Baeckmann, A.; Neuber, J. (to Gesellschaft fuer Kernforschung mbH). German Patent 2,146,774. 5 Apr 1973. 12p. (In German).

A method is described for the completely remote-controllable x-ray fluorescence analysis of fissile and/or fertile materials (Th, U, Np, Pu, Am, Cm) in aqueous or organic solutions in a reprocessing plant (safeguards). The total equipment consists of a glovebox containing sample-preparation and sample-transport equipment, a remote-controlled sample changer, an x-ray fluorescence spectrometer with high-voltage generator and counter electronics, and a computer for the processing control and the calculation of analysis data. (GE)

27023 METHOD FOR THE DETERMINATION OF HEAVY ELEMENTS BY X-RAY FLUORESCENCE ANALYSIS. Neeb, K. H.; Neidl, H.; Weisse, H. J. (to Siemens AG). German Patent 2,140,794. 15 Feb 1973. 3p. (In German).

The method concerns the x-ray fluorescence analysis of heavy elements in gaseous, liquid, and solid samples in a container whose whole surface is mechanically stable. Beta-radionuclide sources with sufficient energy for the excitation of the K-fluorescence are used, i.e., ^{90}Sr, ^{90}Y, ^{99}Tc, and ^{204}Tl. The complex fluorescence radiation is non-dispersively analyzed by means of a semiconductor detector. (GE)

27024 CONVENIENT METHOD FOR LIQUID SCINTILLATION COUNTING OF BARIUM CARBONATE-^{14}C. Larsen, P. O. (Kong-lige Veterinaer- og Landbohoejskole, Copenhagen). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 612-613(Oct 1973).

An attractive method of liquid scintillation counting of $BaCO_3$, especially when only small quantities of $BaCO_3$ are present, is by direct solution of $BaCO_3$ in an alkaline system. This can be done by dissolving $BaCO_3$ in an aqueous solution of EDTA tetrasodium salt as required by the solubility product for $BaCO_3$ and the stability constant for the Ba-EDTA complex. The results indicate that small samples of $BaCO_3$ can easily be counted by this method with high reproducibility and accuracy. (UK)

27025 CALORIMETRIC DETERMINATION OF THE Pu CONTENT OF NUCLEAR FUELS PRIOR TO THEIR IRRADIATION IN A REACTOR. Meniere, J. M. (CEN de Cadarache, Saint Paul-les-Durance, France); Ganivet, M.; Parin, H.; Patin, C. Rev. Gen. Therm.; 12: No. 138, 549-558(Jun 1973). (In French).

From meeting on calorimetry and differential analysis; Paris, France (4 May 1972).

The measurement of the thermal energy generated by the emission of α and β radiations from various plutonium isotopes provides a nondestructive method for determining this element in its compounds. The method used is described together with the effect of the isotopic composition of the plutonium and the americium contents on the results obtained. An accuracy of between ±0.1 and ±0.5% can be obtained, the reproducibility of the results being better than 0.1%. This method of analysis suggests the construction of thermal conduction calorimeters for controlling the quantity of plutonium in nuclear fuel elements before their loading in reactors. (FR)

27026 X-RAY SPECTROMETRY FOR PARTICULATE AIR POLLUTION: A QUANTITATIVE COMPARISON OF TECHNIQUES. Gilfrich, J. V.; Burkhalter, P. G.; Birks, L. S. (Naval Research Lab., Washington, DC). Anal. Chem.; 45: No. 12, 2002-2009(Oct 1973).

X-ray fluorescence spectrometry is well suited to the determination of elemental composition of air pollution particulate samples because no sample preparation is required for filter collections, 100-second detection limits are 1 to 100 ng/cm^2 for most elements of interest, the technique is nondestructive, and 10 or 20 elements can be measured simultaneously using presently available commercial equipment. The best detection limits are achieved by reducing the background primary radiation scattered into the measuring system by the sample and its filter substrate. Comparisons are made among various excitation sources, x-ray tubes, fluorescers, radioisotopes and 5-MeV protons and alpha particles, and between wavelength dispersion using a crystal spectrometer and energy dispersion using a Si(Li) solid state detector. Incinerator and other actual samples are analyzed to show application of the method. (auth)

27027 LOW-TEMPERATURE SOLID SCINTILLATION FLUOROGRAPHY APPLIED TO RADIOCHROMATOGRAPHY WITH WEAK β-EMITTERS. Prydz, S.; Melo, T. B.; Koren, J. F. (Univ., Oslo). Anal. Chem.; 45: No. 12, 2106-2111(Oct 1973).

A short introduction is given to the use of the photographic detection of radionuclides in chromatography by means of scintillators admixed to the chromatograms. On the basis of a theoretical treatment of the photoemulsion response at very low exposure intensities, many of the observations can be given a satisfactory explanation and some possible experimental improvements can be suggested. An explanation has been provided for an observed low-temperature enhancement of the photoemulsion sensitivity which may become of great importance for the detection of tritium and radiocarbon. (auth)

27028 SIMULTANEOUS ASSAY OF SAMPLES CONTAINING THREE RADIOACTIVE ISOTOPES BY A LIQUID SCINTILLATION SPECTROMETER. Saxena, R. K.; Gambhir, P. N. (Nuclear Research Lab., New Delhi). pp 539-543 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231.

27029 DETERMINATION OF IODINE IN CONTRAST MEDIA USING RADIOISOTOPE X-RAY FLUORESCENCE ANALYSIS. Industrial Tests. Havranek, E.; Bumbalova, A.; Nemcikova, A.; Stuchlik, J. (Charles Univ., Bratislava). Cesk. Farm.; 22: No. 3, 130-132(Apr 1973). (In Czech).

In the pharmaceutical industry the RFA method was used for the determination of iodine in roentgenocontrast substances. The study was aimed at making possible the use of one calibration curve for the analysis of all iodine preparations of the group of roentgenocontrast substances. The used radiant ^{241}Am with a long half-time of disintegration is optimum from the point of view of industrial practice. It does not demand correction for activity and its small size makes measuring in coaxial geometry possible, 100 ml of the analyzed sample represents a larger layer than the saturated layer for iodine and therefore accurate measuring-out of the sample is not necessary and an approximate filling of the sample tube is sufficient. The analyzed injection solutions were diluted to the concentration at which the course of the calibration curve was linear and the found values were multiplicated for each medicine by the dilution coefficient. The results of practical tests in Léčiva Dolní Měcholupy, national enterprise, were compared with the results of titration determination of the individual preparations. The standard deviation of the RFA determinations in the course of one month achieved the maximum value of ±2 mg of iodine/ml. The achieved results are quite satisfactory from the point of view of industrial practice. (auth)

27030 DETECTION IN MOLYBDENITES OF ETCHED TRACKS FROM FISSION FRAGMENTS, DETERMINATION OF THE EFFECTIVITY OF THEIR RECORDING AND OF URANIUM CONCENTRATION IN THE SURFACE LAYER. Krivokhatskii, A. S.; Zherekhov, V. G. Geokhimiya; No. 8, 1122-1126(Aug 1973). (In Russian).

Facts are given on the detection in molybdenites of etched tracks from fragments of induced fission of ^{252}Cf and ^{235}U and from fragments of spontaneous fission of ^{235}U. The coefficients of the recording effectivity of fission fragments by molybdenites were determined, uranium concentrations in their superficial layer were also determined, and the apparent age of the molybdenites was calculated. Methods of irradiation and etching of the samples are described. (auth)

Separation Procedures

Refer also to abstracts 27120, 27563, 29498, and 29553.

27031 (AAEC/E-258) PERFORMANCE OF POWDERED ION EXCHANGE RESINS. Bull, P. S.; Evans, J. V.; Nicholson, F. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Ion exchange plants are used in nuclear power stations to produce high quality water for the coolant and moderator circuits by removing dissolved and suspended impurities from water. The coating properties and ion exchange performance of powdered ion-exchange resins were examined in a small test facility. Satisfactory resin coatings were obtained with cation : anion resin ratios in the range 1:1 to 3:1 but use of a 9:1 resin ratio resulted in a high pressure drop across the coating. The "settled resin volume" proved to be a reliable guide to the coating performance of resin slurries. The ion-exchange capacity of the cation resin increased to a small extent with a decrease in sodium concentration in the influent water down to 500 $\mu g\ l^{-1}$. Within the ranges examined, resin ratio, resin loading and flow rate had no significant effect on cation capacity. The effect of exhaustion on the pressure drop characteristics and flocculating properties of various resin ratios was investigated. The thermal stability of the powdered anion resin was markedly less than that quoted elsewhere for anion bead resin. (auth)

27032 (AAEC/E-259) CATION-EXCHANGE REMOVAL OF COPPER FROM AMMONIACAL AQUEOUS SOLUTIONS. Bull, P. S.; Evans, J. V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The presence of copper in feedwater of direct cycle nuclear power reactors can lead to deposition in the reactor core of copper oxides on the fuel element surfaces. This report examines the nature of the adsorbed copper ammine species in the resin phase, evaluates their stability constants and compares them with published data obtained in aqueous solution. It extends the study of the adsorption of copper by a strong acid-cation exchanger to solutions containing low concentrations of ammonia (0 to 0.032 M), and copper (10^{-4}M) and differentiates between the role of the ammonium ion and the free ammonia in the ion-exchange process. (auth)

27033 DISTRIBUTION STUDIES OF RADIUM AND OTHER METALLIC ELEMENTS BETWEEN THENOYLTRIFLUOROACETONE IN METHYL ISOBUTYL KETONE AND AQUEOUS SOLUTIONS. Jackson, W. M.; Gleason, G. I. (Oak Ridge Associated Universities, TN). Anal. Chem.; 45: No. 12, 2125-2129(Oct 1973).

Using a standardized procedure previously reported, the distribution of radium and 13 other metallic elements was quantitatively compared, by distributing a radiotracer of the element of interest between an aqueous phase and an organic phase consisting of 0.1 M TTA in MIBK. From the ratio of activity in the organic phase to activity in the aqueous phase, distribution coefficients were calculated as a function of pH (atomic absorption was used for measuring the concentration of magnesium). Using ^{224}Ra, the extraction of radium by TTA in MIBK was successfully demonstrated to occur under almost identical pH conditions as previously reported for barium. In addition, distribution coefficients for reversible extractions into the TTA–MIBK phase from the aqueous phase were measured for magnesium, manganese, cobalt, nickel, copper, praseodymium, lead, and thorium. When the log D values were plotted vs. pH for iron, molybdenum, technetium, tungsten, and gold, the normal S-shaped curves were not obtained. From the data, pH conditions can be selected to allow the separation of the daughter elements, radium and lead, from thorium, as well as for many other element pairs. (auth)

27034 SORPTION OF URANIUM FROM AQUEOUS SOLUTIONS BY MINERAL SORBENTS AND BY CARBON MODIFIED WITH TITANIUM DIOXIDE. Ermolenko, N. F.; Yatsevskaya, M. I.; Nguen, T. N. (Inst. of General and Inorganic Chemistry, Minsk). Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk; No. 3, 65-68(1973). (In Russian).

A series of adsorbents modified by deposition of a thin layer of titanium dioxide on their surface was studied with the goal of improving their effectiveness in extracting U^{6+} from aqueous solutions. Experimental data showed that the effectiveness of carbon, aluminum oxide, and silica gel was improved considerably after TiO_2 was deposited on their porous surface. Adding a complexing agent to the solution, a carboxylic acid for example, improved the extracting ability even more. This was especially noted in case of aluminum oxide modified with TiO_2 in combination with benzoic acid added to the solution; a four-fold increase in the effectiveness of extraction was achieved. (JPRS)

27035 RECENT DEVELOPMENTS IN THE HODOSCOPE CHAMBER TECHNIQUE. Conversi, M. (Univ., Rome). Riv. Nuovo Cim.; 3: No. 3, 233-282(1973).

Topics include spark chambers vs. hodoscope chambers, basic concepts and definitions, methods for the experimental investigation of flash tube properties, theoretical considerations, flash tube discharge mechanism and optical properties, recent improvements in flash tube performance, the hodoscope chamber as a shower detector, some applications to physics, and nonconventional flash tubes and plastic chambers. (86 references) (WHK)

27036 COPRECIPITATION AND ADSORPTION OF HYDROGEN PEROXIDE ON ZIRCONIUM PHOSPHATE PRECIPITATES. Friedmann, C. (Univ., Vienna); Schoenfeld, T. J. Inorg. Nucl. Chem.; 35: No. 10, 3622-3623(Oct 1973).

In previous studies of the coprecipitation of radioantimony with zirconium phosphates, strongly reduced uptake was observed in the presence of hydrogen peroxide. To elucidate the mechanism of this effect an investigation was made whether hydrogen peroxide is coprecipitated with zirconium phosphate. Strong coprecipitation and also adsorption on preformed zirconium phosphate precipitates were observed. Experimental details and results are presented. A mechanism is proposed in which the coprecipitated H_2O_2 is taken up into zirconium phosphate in the form of $Zr-H_2O_2$ complexes. (UK)

27037 EXTRACTION OF THORIUM, NEPTUNIUM, PLUTONIUM, AND AMERICIUM WITH SODIUM AMALGAM FROM AQUEOUS SOLUTION. Kobayashi, Y.; Saito, A. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 35: No. 10, 3605-3610(Oct 1973).

In acetic acid and/or hydrochloric acid solutions the extraction of Th, Np, Pu, and Am with sodium amalgam was investigated by use of the same procedure as in the case of previous uranium extraction, (Malan, et al., J Inorg Chem; 33: 3097 (1971)). The results indicate that Np, Pu, and Am were extracted in high yields (≳95%) from acetic acid solutions and plutonium amalgam containing 50 mg/ml Hg was obtained. Thorium was not extracted from acetic acid solutions, but it was slightly extracted from hydrochloric acid solutions. (auth)

27038 EXTRACTION OF PROTACTINIUM WITH TRIOCTYLAMINE FROM THIOCYANATE SOLUTIONS. Nekrasova, V. V.; Pal'shin, E. S.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow.) Zh. Anal. Khim.; 28: No. 8, 1519-1523(Aug 1973). (In Russian).

The solvent extraction of Pa(V) with trioctylamine (TOA) as the thiocyanate complex was studied as a function of the acidity of the aqueous phase, Pa concentration, and the presence of diverse cations and anions. It was observed that NH_4^+, K^+, and Na^+ affect the extraction of Pa(V) by a xylene TOA solution. The effect of some solvents and alcohols on the extraction was studied. The extraction constant for the protactinium thiocyanate complex was calculated. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 27109, 27710, 27774, 27899, 27911, 29483, 29486, 29494, 29497, 29509, 29514–29520, 29542, 29546, and 29556.

27039 (ANL–8021, pp 4-8) MOLYBDATES. O'Hare, P. A. G. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January–June 1973.

The understanding and prediction of fission-product interactions are very important in the establishment of operating conditions in a reactor. Significant quantities of molybdenum and lesser amounts of rubidium and barium are formed. Thus, the enthalpies of formation of rubidium molybdate and barium molybdate were determined. A by-product of the determinations was the calculation of the enthalpy of formation of the aqueous molybdate ion. The values obtained are $\Delta H_f^\circ(Rb_2MoO_4$, orthorhombic, 298.15°K) = 357.04 ± 0.09 kcal mol^{-1}, $\Delta H_f^\circ(BaMoO_4$, c, 298.15°K) = ~–369.4 ± 0.5 kcal mol^{-1}, and $\Delta H_f^\circ(MoO_4^{2-}$, aq, 298.15°K) = –238.3 ± 0.1 kcal mol^{-1}. (auth)

27040 (ANL–8021, pp 18-22) LITHIUM MONOSELENIDE, Li_2Se. Ader, M. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January–June 1973.

Interest in the development of lithium-chalcogen couples for high-energy batteries has led to a determination of the standard enthalpy of formation of Li_2Se. The technique of fluorine bomb calorimetry was applied to a study of the reaction $Li_2Se(c) + 4F_2(g) \rightarrow 2LiF(c) + SeF_6(g)$. To drive this reaction to completion, an auxiliary combustion aid was needed, and graphite felt was selected. Two series of calorimetric combustions in fluorine were completed to measure the energies of combustion of graphite felt and Li_2Se. From these, the value $\Delta H_f^\circ(Li_2Se$, C, 298.15°K) = ~–106 kcal mol^{-1} was derived. This value must be considered tentative since analysis of the Li_2Se sample is as yet incomplete. (auth)

27041 (ANL-8021, pp 24) MOLECULAR ORBITAL STUDIES: THE VERTICAL IONIZATION POTENTIAL OF AsF. O'Hare, P. A. G. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January–June 1973.

By means of Hartree-Fock molecular orbital calculations, the energy for the vertical ionization process, $AsF(^3\Sigma) \rightarrow AsF^+(^2\Pi)$, was calculated to be 9.4 ± 0.2 eV. The ionization potential indicates that $D_0^\circ(AsF^+) > D_0^\circ(AsF)$, in harmony with ionization of an antibonding electron. (auth)

27042 (SVF-1) TEMPERATURE RESISTANCE OF DIFFERENT FILTER MATERIALS. Elborn, M. (Stiftelsen for

Varmeteknisk Forskning, Studsvik (Sweden)). Sep 1972. 42p. (In Swedish). Dep. NTIS (U. S. Sales Only) $4.25.

The temperature resistance for some filter materials, cotton, nylon, and nomex, for feedwater filtration was investigated. The different materials were examined within the temperature interval 75 to 150°C in both neutral water and in water containing 0.3 ppM ammonia. Results show that none of the filter materials is suitable for water of high temperature. The cotton filters may not be used at temperatures higher than 70 to 80°C. The corresponding temperature for nylon and nomex filters is between 100°C and 110°C. (SW)

27043 (SVF-2) INVESTIGATION OF THE TEMPERATURE STABILITY OF DIFFERENT ION EXCHANGE MATERIALS. Tjaelldin, O. (Stiftelsen for Varmeteknisk Forskning, Studsvik (Sweden)). Sep 1972. 31p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.75.

An investigation was made to compare the temperature stability of different ion exchange materials. The recommendations are that materials of "technical grade" quality can be used up to 100°C. Over 100°C materials of "nuclear grade" quality have to be used. H^+-loaded materials can be used up to 110°, H_4N^+-loaded up to 120°C, and OH^--loaded up to 50 to 60°C. HCO_3^--loaded materials can not be used in power stations. (SW)

Isotope Effects

Refer also to abstract 27065.

27044 STRUCTURAL STUDY BY INFRARED ABSORPTION AND BY RAMAN SCATTERING OF AQUOCARBONATOLANTHANIDATES(III) OF THE GENERAL FORMULA $Na_x[Ln(CO_3)_y(H_2O)_z] \cdot wH_2O$. Taravel, B. (Laboratoire de Structure Moleculaire, Angers, France); Fromage, F.; Delorme, P.; Lorenzelli, V. J. Mol. Struct.; 16: No. 3, 483-498(Jun 1973). (In French).

An infrared and Raman study of sodium aquo-lanthanide(III) carbonates, their deuterated homologues, and their thermal decomposition products has enabled the assignment of the infrared and Raman bands obtained. Structural indications are given about these compounds in the crystalline state and in solution. (auth)

27045 KINETIC AND EQUILIBRIUM ISOTOPE EFFECTS OF TRITIUM SUBSTITUTION. Weston, R. E. Jr. (Brookhaven National Lab., Upton, NY). pp 289-303 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

It is apparent that large kinetic isotope effects are often found for tritium-labeled compounds. In tracer experiments utilizing tritium, observed rate constants could easily differ by an order of magnitude from those for the analogous unlabeled compound. If tritium from a source of HTO at constant specific activity is incorporated into a biological system by irreversible chemical reactions, it will be discriminated against, and the tritium level in the biological system will remain lower than that of the source. Conversely, kinetic isotope effects in the back-exchange to remove tritium after incorporation will favor retention of tritium in the biological system. (auth)

27046 IMPORTANCE OF CARBON-CARBON BOND HYPERCONJUGATION IN THE SOLVOLYSIS OF ENDO-2-NORBORNYL BROSYLATE. Richardson, J. D. East Lansing, MI; Michigan State Univ. (1973). 98p. University Microfilms Order No. 73-20,396.

Thesis (Ph. D.).

Hyperconjugation of strained carbon-carbon σ bonds was suggested as a major source of stabilization for the electron-deficient centers produced during certain types of reactions. To test this suggestion, the secondary γ-deuterium isotope effect for the solvolysis of endo-2-norbornyl-7,7-d_2 brosylate (I) was determined. The isotope effect ($k_H/k_D = 1.015 \pm 0.009$) was found to be essentially constant over a 15° temperature range. A comparison of the activation parameters revealed that the observed isotope effect was due to enthalpy differences between the isotopically related compounds. (Diss. Abst.)

27047 ENTROPY CONTRIBUTIONS TO REMOTE SECONDARY KINETIC HYDROGEN ISOTOPE EFFECTS. Smith, V. F. East Lansing, MI; Michigan State Univ. (1973). 81p. University Microfilms Order No. 73-20,403.

Thesis (Ph. D.).

In an effort to establish the importance of contributions to remote secondary kinetic isotope effects from entropy differences between isotopic substrates, the rates of solvolysis of the 2,6,6-trimethyl-endo-2-norbornyl p-nitrobenzoates were measured in 80% ethanol-water over the temperature range 100° to 150° by a spectrophotometric technique. The isotope effect K_H/K_D ranged in value from 0.997 ± 0.016 at 100.84 to 1.049 ± 0.011 at 150.186°C. (DHM)

27048 METAL ISOTOPE EFFECT ON METAL-LIQUID VIBRATIONS. X. Far-Infrared Spectra of Trans Adducts of Tin-(IV) Tetrahalide with Unidentate Ligands. Ohkaku, N.; Nakamoto, K. (Marquette Univ., Milwaukee). Inorg. Chem.; 12: No. 10, 2440-2446(Oct 1973).

Twelve 1 : 2 adducts of tin tetrahalides with various unidentate ligands, SnX_4L_2, were prepared, and their far-infrared spectra were assigned based on $^{116}Sn-^{124}Sn$ isotopic shifts. Cis and trans structures were distinguished from the number of observed Sn-X and Sn-L stretching modes. It was shown that all the complexes studied are trans. (auth)

27049 METAL ISOTOPE EFFECT ON METAL-LIGAND VIBRATIONS. XI. Far-Infrared Spectra of Cis-$SnX_4(L-L)$ Type Complexes. Ohkaku, N.; Nakamoto, K. (Marquette Univ., Milwaukee). Inorg. Chem.; 12: No. 10, 2446-2449(Oct 1973).

Eleven tin tetrahalide adducts with various bidentate ligands, cis-$SnX_4(L-L)$, were prepared, and their far-infrared spectra were assigned based on the observed $^{116}Sn-^{124}Sn$ isotope shifts. (auth)

27050 HALOMETHYL-METAL COMPOUNDS. LXIII. Insertion of Phenyl(bromodichloromethyl)mercury-derived Dichlorocarbene into Benzylic Carbon-Hydrogen Bonds. Stereochemistry and Mechanism. Seyferth, D.; Cheng, Y. M. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Chem. Soc.; 95: No. 20, 6763-6770(3 Oct 1973).

The insertion of phenyl(bromodichloromethyl)mercury-derived dichlorocarbene into the benzylic C-H bond of (+)-2-phenylbutane occurs with predominant retention of configuration. The kinetic deuterium isotope effect for this process was determined to be 2.5. In a Hammett study, pairs of substituted cumenes, $ZC_6H_4-CMe_2H$ (Z = p-CH_3,H,p-F,p-Cl,m-CF_3), were allowed to compete for a deficiency of $PhHgCCl_2Br$. These experiments demonstrated an equally good linear correlation of the log k_{rel} values with σ and σ^+ values, giving ρ values of −1.19 and −0.894, respectively. These results show that the insertion reaction in question is a concerted process in which a small partial positive charge is developed at the carbon atom into whose bond to hydrogen CCl_2 is being inserted. (auth)

27051 SOLVOLYSIS OF OPTICALLY ACTIVE 1-PHENYLETHYL CHLORIDE. Polarimetric Rates, Deuterium Isotope Effects, Product Configurations, and Mechanisms. Shiner, V. J. Jr.; Hartshorn, S. R.; Vogel, P. C. (Indiana Univ., Bloomington). Contract AT(11-1)-1008. J. Org. Chem.; 38: No. 20, 3604-3610 (5 Oct 1973). (COO-1008-22).

For 1-phenylethyl chloride, the rate of change of optical activity is found to exceed the solvolysis rate by factors of 1.72, 1.16, and 1.07, respectively, in solvents 97% 2,2,2-trifluoroethanol-3% water (97 T), 80 vol. % ethanol-water (80 E), and 60 vol. % ethanol-water (60 E). α- and β-deuterium effects on the rates of change of optical activity are observed to be similar to those on the rates of solvolysis. The products in all three solvents show appreciable optical activity, indicating that nucleophilic attack on the carbonium ion fragment occurs before the leaving group has completely diffused away. The importance of internal ion-pair recombination is indicated by the initial formation of 1-phenylethyl chloride in sixfold excess over 1-phenylethyl trifluoroethyl ether in the reaction of undissociated HCl with styrene in pure trifluoroethanol (100 T). These results can be nicely accommodated by the solvolysis scheme involving two ion-pair intermediates. Applying this scheme to the present results one concludes that in these solvolyses the tight ion pair is the key intermediate; in 97 T-100 T for every 100 tight ion pairs produced 80 return, 13 solvolyze (via the solvent separated ion pair), and 7 invert their configuration; in 60 E, of 100 formed, 70 return, 28 solvolyze, and 1.4 invert. α- and β-deuterium effects on the rates of acid-catalyzed racemization of 1-phenylethanol in trifluoroethanol-water mixtures indicate that the rate-determining step is the ionization of the C-O bond of the conjugate acid. (auth)

27052 EFFECT OF $H_2^{18}O$ ON THE pH OF PHOSPHORIC ACID SOLUTIONS. Kudish, A. I.; Wolf, D.; Pinchas, S. (Weizmann Inst. of Science, Rehovoth, Israel.) J. Inorg. Nucl. Chem.; 35: No. 10, 3637-3638(Oct 1973).

It is shown that (a) the acidity of phosphoric acid in pure $H_2^{18}O$ (pH = 2.064) is significantly less than in $H_2^{16}O$ (pH = 2.048), and (b) the rise in the pH of the $H_2^{18}O$ acid solution upon dilution with $H_2^{16}O$ is less steep than in the corresponding $H_2^{16}O$ solution. (UK)

27053 IR SPECTRA OF NON-DEUTERATED AND DEUTERATED POTASSIUM POLYBORATES. Heller, G.; Giebelhausen, A.

(Freie Univ., Berlin). J. Inorg. Nucl. Chem.; 35: No. 10, 3511-3516(Oct 1973). (In German).

The polyborates $K[B_5O_6(OH)_4]$ and $K_2[B_6O_7(OH)_6]$ were partially deuterated during their preparation. Their ir spectra were correlated. An attempt was made to attribute all bands to vibrations of the different bonds in the molecules. The mechanism of the reaction during preparation is discussed. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 27064, 27067, 27129, 27224, 27272, and 27700.

27054 (JUL-912-PC) CHEMOSTAT FOR THE STUDY OF ISOTOPE FRACTIONATION OF OXYGEN IN THE RESPIRATION OF MICROORGANISMS. Schleser, G.; Foerstel, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie). Dec 1972. 63p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Laboratory equipment (chemostat) is described that has been designed to measure the oxygen isotope fractionation in the process of bacterial respiration. The culture dish cannot be aerated and the oxygen is supplied exclusively via the nutrient solution. The device can be operated so as to enable different specific respiration rates to be imposed on one bacterial group. The various functions of the system are explained, followed by a short description of the technical set-up. Batch cultures were used to determine the parameters describing the system and to verify the theoretically derived operating conditions. (INIS)

27055 ACIDITY OF NICKELOCENE AND THE KINETIC ISOTOPE EFFECT DURING ITS BASE-CATALYZED HYDROGEN EXCHANGE. Bykova, E. V.; Yakushin, F. S.; Setkina, V. N.; Kursanov, D. N.; Shatenshtein, A. I. (Inst. of Elemental-Organic Compounds, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1398-1401(Jun 1973). (In Russian).

The rate constants of the deuterium and tritium exchange of nickelocene, ferrocene, triphenylmethane, and diphenylmethane with bases were measured. It was established that the kinetic acidity of these compounds and cyclopentadienylmanganese tricarbonyl (CTM) increases in the following series: ferrocene < CTM < diphenylmethane < triphenyl methane < nickelocene. The kinetic isotope effect of the exchange reaction of nickelocene with bases and in the cases of ferrocene and CTM was determined; the reaction proceeds by the mechanism of protophyl substitution of hydrogen. (tr-auth)

27056 ISOTOPE ENRICHMENT PROCESS USING THE HOT/COLD TECHNIQUES. Spevack, J. S. German Patent 1,544,134. 19 Apr 1973. 4p. (In German).

The patent deals with the hot/cold exchange of an isotope (deuterium) between a liquid (water) and a gaseous phase (hydrogen sulfide) both containing the isotope in question and flowing in opposite directions (counter current system). The liquid phase leaving the hot zone is led in a counter current to a stream of the liquid phase of still higher temperature in a gaseous state. Its noncondensed parts are led into the hot zone of the first stage together with gaseous parts escaped from the liquid phase. The liquid phase flowing from the cold to the hot zone is preheated by the liquid phase which leaves the skimmer after having delivered a part of its heat to the liquid stream entering the skimmer. (GE)

27057 ELECTROPHORETIC STUDY OF THE ISOTOPE EXCHANGE REACTION IN THE LITHIUM-6-LITHIUM-7-WATER-ETHYLENEDIAMINETETRAACETIC ACID SYSTEM. Stepanov, A. V.; Aleksandruk, V. M.; Stepanova, N. D. (Leningrad Technological Inst.). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 176-177(Feb 1973).

Translated from Zh. Fiz. Khim.; 47: No. 2, 309-311(Feb 1973).

The isotope effects in the migration of the hydrated ^6Li and ^7Li cations in 0.1 M NH_4Cl solution ($\Delta u/|u| = 0.0039 \pm 0.0004$) and of the lithium complexes of ethylenediaminetetraacetic acid H_4Y in 7×10^{-2} M H_4Y solution at pH 10.6 ($\Delta u/|u| = 0.0020 \pm 0.0004$) as well as the isotope exchange constant $K_{exch} = [^6LiY^{3-}][^7Li^+(aq)]/[^7LiY^{3-}][^6Li^+(aq)] = 1.002 \pm 0.002$ were measured with the aid of apparatus for electrophoresis in an inert porous filler (quartz sand) at 20°C. (auth)

Feed Materials Processing

Refer also to abstract 27210.

27058 FROM MINES TO FABRICATED FUEL. pp 205-215 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Since the production of nuclear energy is presently based on uranium, consideration is given to mining, concentrating, refining, and enriching of uranium and to fuel element manufacturing. Thorium as a fuel is considered only briefly. (DHM)

27059 MINING AND REPROCESSING OF URANIUM IN CAPITALIST COUNTRIES. Chesnokov, N. I.; Ivanov, V. G. At. Energ. (USSR); 35: No. 1, 37-46(Jul 1973). (In Russian).

Information is summarized on uranium stocks and a description presented of uranium deposits in capitalist countries. Methods of working uranium mines and schemes for opening deposits to exploitation are discussed; information on mechanization methods used in uranium mining is presented. The technology of uranium ore excavation and systems of working uranium are described. The open-cut method of mining uranium is analyzed and special methods of mining uranium are discussed: a method of underground leaching by means of special solutions and a new method of hydromining through wells. A description of hydrometallurgical reprocessing of uranium ores is presented and various data on uranium-industry economics in capitalist countries are discussed and summarized. (auth)

27060 PROCESS FOR PRODUCING AMMONIUM DIURANATE. Gerrald, L. D. (to Westinghouse Electric Corp.). Patent 3,758,664. 11 Sep 1973. Filed date 29 Dec 1970. 8p.

A process is reported for the recovery of uranium as ammonium diuranate from aqueous solutions having uranyl and fluoride ions such as those produced by hydrolyzing UF_6, and for reducing soluble uranium losses in the liquid waste stream. A first neutralized solution of uranyl fluoride (UO_2F_2), is formed with concentrated ammonium hydroxide, at a pH of about 4.5 to 6.0, and then by precipitating essentially all of the uranium, as ammonium diuranate, $[(NH_4)_2U_2O_7]$, (ADU), from the solution by adding concentrated ammonium hydroxide under controlled conditions. Thus the formation of any soluble fluoride complexes that would otherwise be ordinarily formed during the precipitation of the ammonium diuranate is prevented. An ADU slurry that is calcinable to UO_2 having good ceramic pelletizing properties is produced. (Official Gazette)

Radiation Chemistry

Refer also to abstracts 27093, 27119, 27540, 27549, 27912, 27913, 27924, and 27934.

27061 (AEC-tr-7223/11-12) NUKLEONIKA. Translated from Nukleonika; 16: No. 11-12, 513-632(1971). 116p. (TT-70-55104/11-12). Dep. NTIS $8.00.

27062 (BNWL-1751(Pt. 2), pp 105-107) TIME RESOLVED EMISSION SPECTROSCOPY. West, M. L. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The luminescence intensity-time curves of dilute solutions of organic scintillators in alphatic hydrocarbons excited by ionizing radiation display nonexponential decay. Reasons for this nonexponential decay are related to the primary interactions between particles and the media and to the physico-chemical processes which occur. Studies of these decay curves under controlled experimental conditions in an effort to gain insight into some of the early processes are briefly described. (WHK)

27063 (COO-3381) INTERACTION OF RADIATION WITH MATTER. Progress Report, August 1, 1972-July 31, 1973. Brandt, W.; Pope, M. (New York Univ., N. Y. Radiation and Solid State Lab.). Apr 1973. Contract AT(11-1)-3381. 287p. Dep. NTIS $16.50.

Progress is reported in energy conversion processes in organic systems and heavy ion physics. The following topics were studied: energy conversion mechanisms in α-particle tracks, optically induced singlet fission in tetracene, energy transfer in upper excited singlet states, singlet fission in upper excited states of anthracene, photoinjection of holes into anthracene crystals using aqueous I_3^- solutions and a magnetic field, luminescence and photoconductivity of nitronaphthalenes, quenching of excited triplets of monomethyl derivatives of benz(a)anthracene by molecular O_2, magnetic field effect on delayed fluorescence from pyrene crystals, and heterofission of singlets into triplets. Heavy-ion physics studies include: K-shell ionization in ion-atom collisions, combination polarization and binding effect and electronic structure effects, binding and Coulomb deflection effects in L-shell ionization by heavy charged particles, low-energy nuclear stopping, channeling, positron annihilation in solids, and markers on DNA molecules. (DLC)

27064 (TID-26447) STUDY OF THE RADIATION INDUCED EXCHANGE OF OXYGEN-18 IN INORGANIC MOLECULAR IONS. Holtzscheiter, E. W. Jr. (Maryland Univ., College Park). 1973. Contract AT(40-1)-3660. 150p. Dep. NTIS $9.50.

Thesis.

An oxygen exchange reaction is observed during the radioinduced decomposition of inorganic oxganions when these salts are irradiated in an atmosphere of ^{18}O. This reaction or series of reactions is capable of enriching nitrates, chlorates, bromates, and iodates in ^{18}O by simply irradiating the compounds in the presence of ^{18}O gas. (DHM)

27065 (TID-26448) RADIATION INDUCED DECOMPOSITION OF INORGANIC MOLECULAR IONS. Progress Report. Johnson, E. R. (Maryland Univ., College Park. Coll. of Engineering). 1973. Contract AT(40-1)-3660. 6p. Dep. NTIS $3.00.

Progress in studies of the radioinduced decomposition of $NaNO_3$ is reported. It was concluded that the apparent increase in nitrate yield when $NaNO_3$ is irradiated and analyzed by the ceric sulfate reduction method is due entirely to surface impurities. An attempt was made to develop a mechanism for the decomposition of $NaNO_3$. The decomposition was studied as a function of temperature and in the presence of additives, primarily nitrite ions. In addition, the ^{18}O isotope effect was determined. Results indicate that the isotope effect is not very temperature sensitive whereas the G value for decomposition is. Radioinduced exchange reactions between ^{18}O and some inorganic solids were studied. Compounds studied were chlorates, bromates, iodates, sulfates, and carbonates of potassium. (JGB)

27066 2,2,4,6,6-PENTAMETHYLHEPTANE RADIOLYSIS. Pichuzhkin, V. I.; Antonova, E. A.; Chervoneva, L. A.; Saraeva, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 2, 155-158 (1973). (In Russian).

The radiolysis of 2,2,4,6,6-pentamethylheptane was studied in the presence and absence of nitrous oxide or decene-1. About 60% of the radiolysis products with C–C bond rupture were formed by a molecular mechanism. (auth)

27067 RADIOLYTIC DISPLACEMENT OF SUBSTITUENT GROUPS IN BENZENE BY HYDROGEN (TRITIUM). Brett, C. L.; Gold, V. (King's Coll., London). J. Chem. Soc., Perkin Trans., II; No. 10, 1453-1456(1973).

The experimental work examines the extent to which β-radioinduced hydrogen exchange of aromatic substrates in aqueous solution with the solvent is accompanied by displacement of a substituent group in the aromatic compound. Radioinduced substituent displacement is observed to any significant extent only for the halogenobenzenes (PhI > PhBr > PhCl). A dual function is ascribed to copper(II) ions, which act as inhibitor of both exchange and substituent displacement; they act as oxidizing agent towards hydrogen atoms and substituted cyclohexadienyl radicals with attendant formation of the corresponding cations. This model explains why, in the case of bromobenzene, copper(II) ions inhibit the substituent displacement reaction more than the tritium exchange. (auth)

27068 RADIATION CHEMISTRY OF WATER. A Comparison of γ RAYS AND TRITIUM β's. Gagnon, W. F.; Appleby, A. (Rutgers–The State Univ., New Brunswick, NJ). pp 192-198 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A study was made in an effort to compare the chemical properties of short tracks and spurs by parallel experiments using either tritium β particles or γ rays. The yield of H_2 or H_2O_2 should be somewhat more difficult to suppress by added solutes if it were formed in short tracks rather than in spurs. To test this hypothesis the H_2O_2 yield was measured as a function of both Br^- and Tl^+ as scavengers. It was found that in both cases the H_2O_2 yield in tritium β radiolysis was more easily suppressed than in the case of ^{60}Co γ radiolysis. Possible explanation might involve the longer time scale over which H_2O_2 formed in short track geometry as compared with spur geometry. (DHM)

27069 OXYGEN EFFECTS IN THE GAMMA RADIOLYSIS OF ACIDIFIED WATER. Alkaitis, S. A. Los Angeles; Univ. of California (1973). 170p. University Microfilms Order No. 73-18,611.

Thesis (Ph. D.).

The effect of oxygen concentration, up to a saturating oxygen pressure of 118 atm, in the ^{60}Co γ-radiolysis of aqueous 0.8 N H_2SO_4 solutions of Ce^{+4}, $Ce^{+4} + Tl^{+1}$, HCOONa, and Fe^{+2} was determined. $G(Ce^{+3})$, $G(H_2O_2)$, and $G(Fe^{+3})$ were found to increase with increasing oxygen concentration, the scavenging curves falling into two distinct regions at greater than and less than $PO_2 \approx 60$ atm. G_{OH+SO_4} remained constant over the whole range of oxygen pressures employed. Homogeneous kinetics described the scavenging curves at $PO_2 \lesssim 60$ atm. The increase in yields with oxygen pressure up to $PO_2 \approx 60$ atm was shown to be consistent with the oxygen dependent radiolytic production of two distinct species identified as HO_2 and $O_2(^1\Delta_g)$. Singlet oxygen oxidation of Fe^{+2} was shown to occur in a nonradiolytic system by means of externally generated $^1\Delta_g$ in a microwave discharge. The limiting yields of the species were $G(HO_2) = 0.25$ and $G(O_2{}^1\Delta_g) = 0.61$. Identifying $H_2O(^3B_1)$ as the most likely precursor of $O_2(^1\Delta_g)$, the radiolytic yield of oxygen scavengeable triplet water in the range of $PO_2 \lesssim 60$ atm is $G(H_2O, {}^3B_1) \cong 0.61$. (Diss. Abstr.)

27070 REDUCING SPECIES REACTIONS WITH SULFHYDRYL COMPOUNDS OF BIOLOGICAL INTERESTS IN ACIDIC AQUEOUS SOLUTIONS. Tung, T. L. Columbia, MO; Univ. of Missouri (1972). 146p. University Microfilms Order No. 73-21,493.

Thesis (Ph. D.).

The rates of the H atom and the hydrated electron reactions with sulfhydryl compounds in acidic aqueous solutions were studied. Six sulfhydryl compounds were especially chosen for investigation from three different categories in respect to their primary, secondary, and tertiary structures of the -SH group. Among them, four primary-SH compounds contain different functional groups. All sulfhydryl compounds (RSH) studied have the same skeletal structure as ethanethiol. Biological effects, namely radiation protection and sensitization, were also considered in the choice of some of these compounds. For primary-SH compounds, the effect of functional groups on the reactivity of the adjacent -SH group with the H atom has the following order: NH_3^+ < COOH < amino acid group, and OH. The effect of structures of the -SH group on the rates shows that primary RSH compounds undergo predominantly the abstraction reaction (formation of H_2), while secondary and tertiary RSH compounds undergo predominantly addition reactions (formation of H_2S) with the H atom. It is pointed out that the activation energy of the abstraction reaction is lower than that of the addition reaction for primary RSH, but the trend is reversed for secondary and tertiary RSH. In the study of hydrated electron reactions, the rate constants of hydrated electron reactions with four RSH compounds in the acidic region were evaluated. Two of the RSH compounds studied were amino acids of biological interests, namely cysteine and penicillamine. The variations of the rates of reaction of these two compounds with the hydrated electron were shown in the entire acidic region. Chemical calculations combined with a modified equation of a linear combination of the rate constants were used for theoretical representation of the rate variation. Two factors were considered in the modification of the equation. The first factor was the effect of ionic strength on the rate of reaction between charged species (Debye–Huckel theory was used), and the second factor is the effect of percentage dissociation of the functional group (carboxyl group) on the resulting rate constant. The calculated rates were matched very well with the observed rates. The rates for these two amino acids were shown to decrease continuously from low pH to neutral pH by factors of 2 and 3. The results of H atom reactions studied were related to the H atom repair mechanism of radiobiological systems for radiation protectors and sensitizers. Prediction bases from the chemical point of view were suggested for RSH compounds which are radiation protectors and sensitizers. A mechanism of radiation sensitization by a RSH sensitizer is also proposed. (Diss. Abstr.)

27071 CHEMISTRY RADIATION MECHANISM FOR THE DISAPPEARANCE OF PROPANE DURING METHANE RADIOLYSIS. Rogers, D. T. Bozeman, MT; Montana State Univ. (1973). 143p. University Microfilms Order No. 73-19,599.

Thesis (Ph. D.).

The kinetics of gaseous methane radiolysis at room temperature using x-rays as a high energy source was studied using as a reaction chamber a glass syringe with a stopcock attached to it. The rate of disappearance of 1,3-^{14}C-propane and the rate of formation of ^{14}C-methane was studied as a function of energy absorbed. The G values in ultra-high purity methane as a function of propane concentration (molec/cc) were determined to be: $G(-C_3H_8) = 1.18 \times 10^{-15}[C_3H_8]$; and $G(CH_4) = 1.6[C_3H_8]/([C_3H_8] + 2.5 \times 10^{15})$. The presence of air in all samples and the sensitivity of the reaction to the presence of water pointed to an ionic mechanism for methane formation. Since the water concentration needed to be much greater than the propane concentration in order to reduce $G[CH_4]$ by 50%, it was concluded that the heavy ions involved in methane polymerization were the only ions which could reasonably explain why propane reacts more efficiently with a positive ion than does water. Thus, to explain the above equation for $G[CH_4]$, the following reactions were proposed:

$$X^+ + C_3H_8 \rightarrow XC_2H_7^+ + CH_4 \qquad \Delta H = -13 \frac{kcal}{mole} \qquad (1)$$

$$X^+ + C_3H_8 \rightarrow XC_3H_8^+ + H_2 \qquad \Delta H = 0 \frac{kcal}{mole} \qquad (2)$$

$$X^+ + CH_4 \rightarrow XCH_2^+ + H_2 \qquad \Delta H = +3 \frac{kcal}{mole} \qquad (3)$$

where X^+ is a heavy polymerizing ion. The ΔH values were estimated from theoretical ΔH_f values and adjusted to give reasonable consistency with the observed G values. This kinetic scheme predicts that at 300 ppM C_3H_8 the only polymerization reaction of importance proceeds by reactions (1) and (2). This apparently conflicts with previous literature studies, which indicate no dependence of CH_4 polymerization on reaction products (such as propane). These conflicts are explained by a reinterpretation of the data of previous studies. (Diss. Abstr.)

27072 MECHANISM AND KINETICS OF CYCLOHEXYL RADICAL ADDITION TO CHLOROETHYLENES AND OF THE SUBSEQUENT REACTIONS OF THE ADDUCT RADICALS. Horowitz, A.; Rajbenbach, L. A. (Soreq Nuclear Research Center, Yavne, Israel). J. Amer. Chem. Soc.; 95: No. 19, 6308-6313(19 Sep 1973).

The mechanism and kinetics of the free-radical chain addition reaction between cyclohexane (RH) and chloroethylenes (ECl) were reinvestigated. The intermediacy of unimolecular β-chlorine scission from the RECl type radicals in the chain propagation sequence was confirmed. Relative Arrhenius parameters for the addition of R radicals to C_2Cl_4, C_2Cl_3H, and the cis and trans isomers of $C_2Cl_2H_2$ were determined. Arrhenius parameters for Cl atom elimination from $RC_2Cl_2H_2$ and RC_2Cl_3H radicals were evaluated from studies of the temperature dependence of the yields of the saturated and unsaturated addition products. (auth)

27073 RADIO-CHEMICAL OXIDATION OF HYDROCHLORIC ACID. Schuerer, M. Freiberg i.B.; Bergakademie Freiberg (1972). 146p. (In German).

Thesis.

The radiochemical oxidation of hydrochloric acid was studied in an effort to obtain high yields of chlorine. In addition to the experimental procedure and results, the evaluation with a proposed reaction mechanism, summary and literature (56 references) are described. (GE)

27074 DOUBLE ELECTRON–NUCLEAR RESONANCE OF FREE RADICALS IN γ-IRRADIATED SINGLE CRYSTAL OF GLYCINE. Deigen, M. F.; Krivenko, V. G.; Pulatova, M. K.; Ruban, M. A.; Teslenko, V. V.; Kayushin, L. P. (Inst. of Semiconductors, Kiev). Biofizika; 18: No. 2, 235-242(1973). (In Russian).

A double electron-nuclear resonance study ENDOR was carried out of hyperfine magnetic and quadrupole interactions of the unpaired electron of the radical $NH_3^+\dot{C}HCOO^-$ with the nitrogen nucleus at 77°K. The free radicals were obtained under γ irradiation of glycine monocrystals at 77°K and subsequent heating up to 290°K. An angular dependence of the ENDOR lines of the nitrogen nucleus and values of the constants of hyperline magnetic and quadrupole interaction with this nucleus were obtained. It was found that the direction of the S–N chemical bond in the radical $NH_3^+\dot{C}HCOO^-$ is deviated from that of the bond in an intact glycine molecule by 4°. (auth)

27075 ESR SPECTRA OF UNORIENTED FREE RADICALS OF SULFUR-CONTAINING AMINO ACIDS. Dobrayakov, S. N.; Krivenko, V. G.; Pulatova, M. K.; Sud'bina, E. N. (Inst. of Biological Physics, Pushchino, USSR). Biofizika; 18: No. 2, 223-227(1973). (In Russian).

ESR spectra were calculated of randomly oriented sulfur-containing radicals of cystine and cysteine on the basis of ESR spectra parameters of oriented paramagnetic species observed in γ-irradiated single crystals of cystine dihydrochloride and hydrochloric cysteine at t = –196 and 20°C. The ESR spectra were calculated on computer M-20 for paramagnetic species having three different values of g factor ($g_{xx} \neq g_{yy} \neq g_{zz}$) and for a special case $g_{xx} = g_{yy} \neq g_{zz}$. The ESR spectra were calculated for different values of linewidths ΔH_k. It was found by comparing calculated and experimentally obtained ESR spectra that in γ-irradiated sulfur-containing proteins at –196°C anion-radicals RSS-R are formed; at room temperature, the radicals RS· or RSS· are formed. (auth)

27076 EVIDENCE FOR ION–MOLECULE REACTION OF HYDROGEN TRANSFER IN γ-IRRADIATED 2,3-DIMETHYLBUTANE AT 77K AS STUDIED BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Saitake, Y.; Miyazaki, T.; Kuri, Z. I. (Nagoya Univ., Japan). J. Phys. Chem.; 77: No. 20, 2418-2420(27 Sep 1973).

The occurrence of an H_2 transfer reaction in the solid phase was confirmed by the detection of product cation directly by ESR spectroscopy. When SF_6 is added to 2,3-dimethylbutane (DMB), tetramethylethylene (TME) cation is formed in the radiolysis at 77°K. Yields of TME cation produced in γ-irradiated DMB containing SF_6 at 77°K increase upon the addition of ethylene, propylene, cyclopropane, or isobutene. The increase of the yields of TME cation is due to H_2 transfer from the parent ion of DMB to olefin or cyclopropane. Apparent efficiencies of ethylene, propylene, cyclopropane, and isobutene for the H_2 transfer reaction were different. The yield of TME cation in the γ-irradiated DMB–SF_6 (0.55 mol %)–C_3H_8 (0.55 mol %) in crystal II is much lower than that in crystal I. When DMB containing SF_6 without olefin is γ-irradiated at 77°K, TME^+ is formed. Since the yield of TME^+ does not decrease upon the addition of 2-methyltetrahydrofuran, it is suggested that the ion may be formed by the fragmentation of DMB^+ ion in the solid phase. (auth)

27077 LOW-TEMPERATURE RADIOLYSIS OF ACIDIC AND BASIC LIQUID AMMONIA SOLUTIONS. Blum, A.; Broszkiewicz, R. K. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 14: No. 5-6, 309-315(5 Sep 1973).

Acidic (10^{-2} to 10^{-1} M NH_4CL) and basic (8×10^{-4} to 1×10^{-2} M KNH_2) liquid ammonia solutions were irradiated at –72 ± 3°C with doses of 3×10^{19} to 2×10^{20} eV/g. The yields for acidic solutions are: $G(H_2) = 0.80 \pm 0.04$ $G(N_2) = 0.11 \pm 0.02$ $G(N_2H_4) = 0.15 \pm 0.02$ and for basic solutions: $G(H_2) = 0.85 \pm 0.05$ $G(N_2) = 0.13 \pm 0.03$ $G(N_2H_4) = 0.18 \pm 0.04$ $G(N_3) = 0.05 \pm 0.02$. These yields, similar for basic, neutral and acidic ammonia solutions at –72°C are compared with room temperature yields where exists significant differences between basic and neutral solutions specially for N_2H_4 yields. (auth)

27078 INVESTIGATION OF GAMMA RADIATION EFFECTS ON LEATHER AND HIDES USING ELECTRON PARAMAGNETIC RESONANCE. II. Strakhov, I. P.; Kipnis, A. B.; Levenko, P. I.; Shifrin, I. G.; Pulatova, M. K.; Sheksheev, E. M. (Moscow Light Industry Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Tekhnol. Legk. Prom.; No. 4, 65-68(1971). (In Russian).

When air is present during gamma irradiation of collagen, the free radical concentration is decreased compared with that when the irradiation is in a vacuum. At 290°K, the free radical concentration depends linearly on the radiation dose in air and is an order of magnitude lower than that when the irradiation is in a vacuum at 77°K. The linearity disappears with time (storage of the product) for both air- and vacuum-irradiated samples. (TTT)

27079 INVESTIGATION OF GAMMA RADIATION EFFECTS ON LEATHER AND HIDES USING ELECTRON PARAMAGNETIC RESONANCE. I. Strakhov, I. P.; Kipnis, A. B.; Levenko, P. I.; Shifrin, I. G.; Pulatova, M. K.; Sheksheev, E. M. (Moscow Light Industry Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Tekhnol. Legk. Prom.; No. 4, 54-62(1971). (In Russian).

Structural changes in dry skins and hides caused by low doses of gamma radiation (^{60}Co) were studied by electron paramagnetic resonance (EPR). The free radical concentration in the irradiated samples (77°K in vacuum) varied linearly with the radiation dose from 0.1 to 5 Mrads. Two types of EPR spectra were found for irradiated proteins: symmetrical, having 1, 2, 3, or more absorption lines, typical of proteins with no sulfur-containing amino acids (e.g., collagen); and asymmetrical, having a poorly resolved structure, typical of proteins with such amino acids. The lines are due to interaction of unpaired electrons on the alpha carbon with the nearest protons in the beta position. In irradiated collagen samples heated in a vacuum to 420°K, the free radicals gradually decreased and the spectrum shape changed, probably due to migration of unpaired electrons and to unfreezing of the molecular movement. The equipment used is described and examples of spectra are shown. (TTT)

27080 DETERMINING SOME CHARACTERISTIC NUMBERS OF FREE FATTY ACIDS OF NATURAL FATS AFTER γ IRRADIATION. Bancher, E.; Washuettl, J.; Spaun, R. (Technische Hochschule, Vienna). Fette-Seifen-Anstrichm.; 73: No. 2, 73-75(1971). (In German).

The alteration of some characteristic values of palmitic, stearic, linoleic, and oleic acids after irradiation with γ-rays at 25, 40, 60 and 90 Mrad was investigated. With increasing dose of irradiation the acid value indicated a falling tendency in all cases, whereas the iodine value after γ-irradiation showed varying values. Benzidine value which could be measured at 25 Mrad only, showed a slight increase. At the highest dose of irradiation, peroxide value of saturated and unsaturated fatty acids behaved in different manner; compared to the value obtained at 40 Mrad, a relatively strong increase was observed with saturated fatty acids and a rather considerable decrease was found with unsaturated fatty acids. The refractive index of oleic and linoleic acids increased steadily, cor-

responding to the dose of irradiation on individual fatty acids. (auth)

27081 LUMINOL CHEMILUMINESCENCE INDUCED BY INTERNAL IRRADIATION. γ-Radiolysis. Mantaka-Marketou, A. E.; Marketos, D. G.; Rakintzis, N. T.; Vassilopoulos, G.; Nikokavouras, J. (Democritus Nuclear Research Center, Athens). Z. Phys. Chem.) (Frankfurt); 85: No. 1-4, 106-112(1973).

The chemiluminescence of the aqueous system luminol–NaOH–^{32}P is compared with the radiolysis of luminol induced by a ^{60}Co γ source. The influence of free radical scavengers, such as isopropanol and nitrate ion, in both cases is reported. The light emission on internal irradiation as well as the decomposition of luminol on γ-radiolysis are due solely to the selective reaction of luminol with the OH(O^-) radicals produced by the radiolysis of water. The rate constant of the reaction between luminol and the O^- radical ion was found equal to $(8.76 \pm 0.8) \times 10^8$ M^{-1} sec^{-1}. (auth)

27082 EFFECT OF GAMMA AND NEUTRON RADIATION ON DRUGS. Schulte, K. E.; Henke, G. (Univ., Muenster, Ger.). Arch. Pharm.; 306: No. 3, 182-197(1973). (In German).

Gamma and neutron radiation induces decomposition reactions of many drugs in aqueous solution, leading to a number of reaction products. The decompositions of the compounds are usually proportional to the applied doses, and they are independent of dose rate. Gamma and neutron irradiation of crystalline drugs often causes a change in colour and in only a few cases a slight amount of decomposition. Radioactivity will be induced by neutrons especially in cases where the molecules have as a part of their constitution the elements Na, K, P, Ca, and S, but not in trace quantities. For the estimation of how much radioactivity can be permitted in the drug and still be tolerated by man, it was suggested that the maximum permissible radioactivity be applied to the drugs as is allowed in drinking water in case of emergency (200 μC). Calculations show that this value will not be reached by most drugs taking into account their maximum therapeutic daily doses and a neutron dose of 3.10^{13} n/cm^2, with the exception of infusion solutions with ^{24}Na activity, but this activity decays in a few days. (auth)

27083 RADIATION GRAFTING POLYMERIZATION AS A METHOD FOR MODIFICATION OF POLYMERS AND INORGANIC MATERIALS. Babkin, U. Yu.; Tsetlin, B. L. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 263-269(1973). (In Russian).

The methods of synthesis and the areas of application of grafted systems have been analyzed in which homogeneity or interphase contacts are fixed by the chemical bonds between two types of polymer chains or between the polymer chains and the surface of mineral bodies. The question of the stability of such systems and the distribution of the grafted polymer in such systems is being discussed. Examples of practical utilization of radiation grafting polymerization are described used in modifying textile fibers, fabrics and filtering materials with the overall goal of improving their utilization properties as mineral-organic fillers and pigments. It has been shown that this method has possibilities in producing oriented grafted systems, materials with novel compositions and ion exchange materials. (JPRS)

27084 EPR STUDY OF X-IRRADIATED $[Ni(CN)_4]^{2-}$ IN NaCl. Jain, S. C.; Reddy, K. V.; Gupta, C. L.; Reddy, T. R. (Solid State Physics Lab., Delhi). Chem. Phys. Lett.; 21: No. 1, 150-152 (1 Aug 1973).

EPR study of the x-irradiated diamagnetic $[Ni(CN)_4]^{2-}$ complex in an NaCl lattice has identified two paramagnetic species. The spin-hamiltonian parameters have characterized these species as low-spin d^7 and d^9 complexes which may be represented as $[Ni(CN)_4Cl_2]^{3-} + 2\,\oplus$ and $[Ni(CN)_4Cl_2]^{5-}$, respectively. (auth)

27085 ACID–BASE PROPERTIES OF ORGANIC PEROXY RADICALS, OORH, IN AQUEOUS SOLUTION. Hayon, E.; Simic, M. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 95: No. 20, 6681-6684(3 Oct 1973).

The transient optical spectra and extinction coefficients of the peroxy radicals, $\cdot O_2RH$, of lactic and glycolic acids and of lactamide, glycine anhydride, and N-acetylglycylglycine (where RH_2 = substrate) were observed in oxygenated aqueous solutions using the technique of pulse radiolysis. All these peroxy radicals have maxima at or below 250 nm. From the change of the absorbance of the transient spectra at a fixed wavelength with pH, typical titration curves were obtained from which the ionization constants of these peroxy radicals were determined: $\cdot O_2RH \rightleftharpoons \cdot O_2R^- + H^+$. pK_a values of 5.2, 5.4, 5.8, 7.5, and 9.8 for the peroxy radicals from lactate, glycolate, lactamide, glycine anhydride, and N-acetylglycylglycine, respectively, were derived. The peroxy radicals from acetate ions and sarcosine anhydride did not show any change with pH and do not ionize. These ionization constants are 10 to 12 pH units lower than those of the parent compounds and are shown to be due to the dissociation of the OH and NH groups in these molecules. The odd electron primarily localized on oxygen in peroxy radicals appears to affect and interact with these functional groups when attached on the α-carbon atom. The efficiency and rate of electron transfer from these peroxy radicals to p-benzoquinone (BQ) were determined by monitoring the formation kinetics of the semiquinone radicals $\cdot BQ^-$ and $\cdot BQ^-–H^+$. The acid-base forms of these peroxy radicals showed characteristic properties. The $\cdot O_2RH$ radicals essentially do not transfer an electron to BQ, whereas the $\cdot O_2R^-$ radicals transfer efficiently leading to the formation of $\cdot BQ^-$ with a $k \sim 3–10 \times 10^8$ M^{-1} sec^{-1}. In the absence of an ionizable functional group in an α position to these peroxy radicals, e.g., from acetate ion and sarcosine anhydride, no semiquinone radical was produced. The importance of these results to oxidation and biochemical reactions is indicated. (auth)

27086 STUDY OF THE GASEOUS PRODUCTS OF γ-RADIOLYSIS OF POLYMERS IN THE PRESENCE OF SMALL DOSES OF IRRADIATION. Semenko, E. I.; Myshkovskii, V. I.; Voblikova, V. A.; Vendillo, V. P. Plast. Massy; No. 5, 30-32(1973). (In Russian).

A study was made of the gaseous products formed during γ-irradiation by small (2.5 Mrads) doses of certain polymer materials used in the medical industry: high-density polyethylene, methyl metacrylate–butyl acrylate copolymer, poly(methyl methacrylate), poly(vinyl chloride), and copolymers of styrene with methyl methacrylate, isoprene, and divinyl. From the experimental results presented it can be concluded that by using highly sensitive gas chromatography to analyze the products of radiolysis of certain polymer materials subjected to the effect of sterilizing doses of γ-radiation (2.5 Mrads) it is possible to establish the course of the decomposition processes with the formation of $C_1–C_5$ hydrocarbons, CO, and CO_2. Broad utilization of ionizing radiation to sterilize medical products made of plastics requires a detailed study of the mechanism of the initial stages of the decomposition processes of polymers on irradiation of them by small doses. (JPRS)

27087 RADIATION POLYMERIZATION OF VINYL FLUORIDE. Zaozerov, A. M.; Sorokin, A. D.; Bulygina, L. A.; Volkova, E. V.; Fokin, A. V. Dokl. Akad. Nauk SSSR; 210: No. 2, 349-352(11 May 1973). (In Russian).

In addition to investigating the polymerization rate of vinyl fluoride (VF) as a function of temperature and dose, this study presents the rate constants for the elementary reactions and for the initiation rate. The radiation polymerization of VF proceeds under heterogeneous conditions, since the poly(vinyl fluoride) (PVF) that is formed does not dissolve in the monomer, and take place with an increase in rate with time. The order of the reaction is 0.55 at the dose delivered with 4% conversion. This value is close to the theoretical value of 0.5 for a bimolecular breakup of polymeric radicals. The effective activation energy is low (4.3 kcal/mol), a fact characteristic of radical polymerization by radiation. The reaction is inhibited by addition of an organic compound (DFPG). The overall reaction rate is represented by a function involving the reaction constants of the elementary reactions and of the initiation reaction. (SJR)

27088 FORMATION OF 1,4-PYRONES IN THE RADIOLYSIS OF STARCH. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Naturforsch., c; 28c: No. 5-6, 14-20(1973). (In German).

Two-dimensional thin layer chromatography of the low molecular weight degradation products in irradiated starch (radiation dose 5 Mrad) showed spots that absorbed strongly in the uv region at 254 nm and produced red-violet color with alcoholic $FeCl_3$ solution. By repeated thin layer chromatography in micropreparative scale, by gas chromatography of the acetyl derivates, and by mass spectrometry the main component was identified as hydroxylmaltol (2-hydroxymethyl-3-hydroxy-4H-pyran-4-one). (auth)

27089 EFFECT OF γ-RADIATION ON THE ELECTRIC PROPERTIES OF METAL POLYMERS BASED ON POLYCAPROAMIDE. Khimchenko, Yu. I.; Meleshevich, A. P.; Kompaniets, V. A.; Radkevich, L. S. Plast. Massy; No. 5, 27-29(1973). (In Russian).

A study was made of the effect of γ-radiation on the electric properties of polycaproamide filled with highly dispersed metals. The electrical conductivity of the metal polymers depends essentially on the radiation dosage. The greatest increase in electrical conductivity is observed for polycaproamide filled with copper or nickel; the electrical conductivity of polycaproamide with iron or cobalt depends on the radiation dosage to a lesser

degree. The variations in electrical conductivity are caused by the difference in supramolecular structures of the polymer in contact with different metals. By variation of the electrical conductivity in combination with ionizing radiation, it is possible to estimate the uniformity of the structure of the polymer compounds with electrically conducting fillers. (JPRS)

27090 RADIATION–CHEMICAL SYNTHESIS. Vereshchinskii, I. V. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 278-284(1973). (In Russian).

A review is presented with 53 references in which general characteristics of the processes of radiation synthesis are formulated and their classification reported; the radiation and photochemical initiation methods are compared. Specific radiation synthesis processes were analyzed for fine chemical products, perfumes, phosphorus-organic compounds of several classes, lead-organic compounds. Several novel routes of radiation synthesis of so far unknown compounds are discussed. (JPRS)

27091 THERMAL DECOMPOSITION OF PREIRRADIATED (γ-RAYS) LITHIUM AZIDE. Prout, E. G.; Liddiard, V. C. (Cape Town Univ., South Africa). J. Inorg. Nucl. Chem.; 35: No. 10, 3419-3427(Oct 1973).

The effect of preirradiation on the subsequent thermal decomposition of lithium azide powder and pellets was studied. The induction period is shortened and the acceleratory and decay rate constants increased. The pressure-time plots of the thermal decomposition of preirradiated pellets of lithium azide are complex. The activation energies associated with the induction, acceleratory and decay reactions are 21, 27, and 28 kcal $mole^{-1}$, respectively, in the temperature range 115 to 190°C. Mechanisms of decomposition are proposed. (auth)

27092 ESR SPECTRA OF X-IRRADIATED CRYSTALLINE DIPHENYLTHIOPHOSPHINE. Geoffroy, M. (Univ., Geneva). Helv. Chim. Acta; 56: No. 5, 1552-1557(18 Jul 1973). (In French).

The electron spin resonance spectra of x-irradiated diphenylphosphine sulfide monocrystal and powder are reported. The results show that the radical Φ_2PS is mainly produced. The values and directions of the principal components of $\bar{g}$ and ^{31}P-hyperfine tensors are determined. (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

27093 (COO-3283-4) STUDIES IN RADIATION AND HOT ATOM CHEMISTRY. Progress Report. (Johns Hopkins Univ., Baltimore, MD. Dept. of Chemistry). Sep 1973. Contract AT(11-1)-3283. 11p. Dep. NTIS $3.00.

Hot atom studies have included investigations of reactions of molecular deuterium, hydrogen, or neon with F^+ in the ground (^3P) state. Preliminary results of radiation chemical studies on the electron fragmentation of boron trihalides, CF_4, and CF_3Cl are reported. The photoelectron spectrum of pentaborane was measured. Studies on light emission from deuteron- and proton-irradiation H_2O in the vapor and liquid states indicate that the observed light does not arise from excited species derived from H_2O. (JGB)

27094 REACTIONS OF RECOILING GERMANIUM ATOMS IN GERMANE, DIGERMANE, AND GERMANE–SILANE MIXTURES. Gaspar, P. P.; Frost, J. J. (Washington Univ., St. Louis). J. Amer. Chem. Soc.; 95: No. 20, 6567-6574(3 Oct 1973). (COO-1713-33).

Product studies on reactions of recoiling germanium atoms in germane, digermane, and germane–silane mixtures support a mechanism in which $^{75}GeH_2$ is an important intermediate giving rise to a next higher homolog of the substrate and also to products of unimolecular decomposition of the higher homolog. Scavenger, moderator, and pressure dependence experiments are discussed, as is the possibility that $^{75}Ge^+$ is an active intermediate. A complete mechanism is suggested for the reactions of germanium atoms recoiling in germane and germane–silane mixtures: $^{75}Ge + GeH_4 \rightleftharpoons (H^{75}GeGeH_3)^*$; $^{75}Ge + SiH_4 \rightleftharpoons (H^{75}GeSiH_3)^*$; $(H^{75}GeGeH_3)^* + M \rightarrow H^{75}GeGeH_3$; $(H^{75}GeSiH_3)^* + M \rightarrow H^{75}GeSiH_3$; $(H^{75}GeGeH_3)^* \rightarrow {}^{75}GeH_2 + GeH_2$; $(H^{75}GeSiH_3)^* \rightarrow {}^{75}GeH_2 + SiH_2$; $H^{75}GeGeH_3 + GeH_4 \rightarrow GeH_3{}^{75}GeH_2GeH_3$; $H^{75}GeGeH_3 + SiH_4 \rightarrow SiH_3{}^{75}GeH_2GeH_3$; $H^{75}GeSiH_3 + GeH_4 \rightarrow SiH_3{}^{75}GeH_2GeH_3$; $H^{75}GeSiH_3 + SiH_4 \rightarrow SiH_3{}^{75}GeH_2SiH_3$; $^{75}GeH_2 + GeH_4 \rightleftharpoons (^{75}GeH_3GeH_3)^*$; $^{75}GeH_2 + SiH_4 \rightleftharpoons (^{75}GeH_3SiH_3)^*$; $(^{75}GeH_3GeH_3)^* + M \rightarrow {}^{75}GeH_3GeH_3$; $(^{75}GeH_3SiH_3)^* + M \rightarrow {}^{75}GeH_3SiH_3$; $(^{75}GeH_3GeH_3)^* \rightarrow {}^{75}GeH_4 + GeH_2$ (4); $(^{75}GeH_3SiH_3)^* \rightarrow {}^{75}GeH_4 + SiH_2$. (auth)

Properties of Radioactive Materials

Refer also to abstracts 27037, 27212, 27577, and 27939.

27095 (AED-CONF-71-400, pp 263-270) NONSYNTHETIC ^{11}C LABELING OF ORGANIC COMPOUNDS. Trampisch, W.; Sattler, E. L. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

With amino acids as example, it was found that a direct ^{11}C labeling was possible through the photo nuclear effect. Both the yield of the labeling and the degree of destruction of the compound during activation in the solid state depended on the chemical structure of the material. (HBG)

27096 (ANL-8021) CHEMICAL ENGINEERING DIVISION THERMOCHEMICAL STUDIES SEMIANNUAL REPORT, JANUARY–JUNE 1973. Hubbard, W. N.; O'Hare, P. A. G.; Johnson, G. K.; Ader, M.; Vogel, R. C.; Burris, L. (Argonne National Lab., Ill). Jul 1973. Contract W-31-109-eng-38. 28p. Dep NTIS $4.00.

A separate abstract was prepared for each of the six sections of the report. (DHM)

For abstracts of individual sections see: 27039–27041, 27097, 27098, and 27710.

27097 (ANL-8021, pp 9-14) SODIUM–URANIUM–OXYGEN COMPOUNDS. O'Hare, P. A. G. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January–June 1973.

One of the safety aspects of liquid-metal-cooled fast-breeder reactors is concerned with the chemical reactions that could occur if the sodium coolant inadvertently contacted the (U,Pu) oxide fuel. For analysis of such a situation, reliable thermodynamic data are needed for compounds in the Na + (U,Pu) + O system. The pure uranium compounds were substituted for the difficult-to-handle U,Pu materials. The differences between the ΔH_f° values for the two types of compounds are not expected to be significant. Data for Na_3UO_4 have already been reported. The study was continued with measurements of the enthalpy of solution of α–Na_2UO_4 in aqueous HCl and the enthalpy of reaction of $NaUO_3$ with acidic XeO_3 solution. The enthalpy of formation values obtained are $\Delta H_f^\circ(\alpha\text{–}Na_2UO_4, c, 298.15°K) = -445.56 \pm 0.85$ kcal mol^{-1} and $\Delta H_f^\circ(NaUO_3, c, 298.15°K) = \sim\!-375 \pm 1$ kcal mol^{-1}. (auth)

27098 (ANL-8021, pp 23) TRIURANIUM SILICIDE (U_3Si). Hubbard, W. N. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January–June 1973.

A cooperative venture was undertaken with the Atomic Energy of Canada to prepare and characterize specimens of U_3Si at Chalk River for thermodynamic studies at Argonne. Specimens have been received for measurements of high-temperature enthalpy increments and heat of combustion in fluorine. The enthalpy increment measurements are complete. For the heat of combustion measurements, the calorimetric system has been calibrated and the combustion measurements have been started. Specimens for low-temperature measurements of heat capacity and entropy have not yet been received. (auth)

27099 (CEA-R-4344) CONTRIBUTION TO THE STUDY OF NUCLEAR RELAXATION AND MOLECULAR MOTIONS IN SOLID HEXAFLUORIDES. Virlet, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug 1973. 161p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

In the pure solid hexafluorides UF_6, WF_6, MoF_6, TeF_6, SeF_6, SF_6, and in the solid solutions $(MoF_6)_x$ $(UF_6)_{1-x}$ molecular motions (reorientation in the low temperature ordered phase, slow translation and fast reorientations in the cubic plastic phase) were studied by ^{19}F Nuclear Magnetic Resonance Relaxation. Ultra-slow motions were studied by measurement of the dipolar energy relaxation rate T_D^{-1}. The calculation of T_D in the weak collision case was performed exactly. The dependence of second moment and relaxation rate values upon reorientational motion models was calculated; special attention being paid to the extent to which the presence of correlations between the reorientation of neighboring molecules could be detected. In the solid solutions, the high value of ^{19}F chemical shifts allowed "high resolution" spectra in the solid to be obtained, even in the ordered phase. The rate of molecular motion was shown to be a quasi-constant at the phase transitions temperatures (reorientations at the solid–solid transition, translation at the melting temperature). (auth)

27100 (KFK-tr-425) EQUATION OF STATE OF URANIUM HEXAFLUORIDE IN A WIDE RANGE OF PARAMETERS OF STATE. Malyshev, V. V. Translated by Rosemarie Corssen

(Kernforschungszentrum, Karlsruhe, W. Ger.) from At. Energ. (USSR); 32: No. 4, 313(1972). 17p. (In German). Dep. NTIS (U.S. Sales Only) $3.00.

This paper was summarized as paper No. 577/6423 with full copy held by TIC.

An exact determination of the experimental data of the compressibility of UF_6 is given with a continuation of experiments in the liquid phase range up to a density of 3.412 g/cm^3 and for pressures up to 242 bar. (INIS)

27101 (SGAE-2145) DECONTAMINATION OF STEELS. Sorantin, H.; Huber, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Institut fuer Strahlenschutz). Jun 1973. 18p. (In German). Dep. NTIS (U.S. Sales Only). $3.00

Steel surfaces contaminated with ^{60}Co, ^{85}Sr, ^{95}Zr, ^{106}Ru, and ^{137}Cs could be cleaned most efficiently with solutions having a pH-value under 4. Of different reagents a solution of 5% EDTA showed best results and lowest corrosion rates after addition of 2% Lutensol-AP 14. An evaluation method for comparing decontamination efficiencies of different solutions was proposed that also takes into account the corrosion rate during the time of application. (auth)

27102 ^{99m}Tc-IRON HYDROXIDE AGGREGATES: A RADIOPHARMACEUTICAL FOR LUNG SCANNING. Singh, B.; Jaiswal, D. K.; Chander, J. (INMAS, New Delhi). Indian J. Radiol.; 25: No. 4, 283-286(1971).

A simple laboratory method of preparation of aggregates is described. The scans obtained are reproducible. (auth)

27103 INVESTIGATION OF ADSORPTION PHENOMENA ON PALLADIUM POWDER BY TRACER METHODS. Horanyi, G. (Central Research Inst. for Chemistry, Budapest). Radiochem. Radioanal. Lett.; 15: No. 1, 1-5(20 Sep 1973).

A method was developed for the investigation of adsorption phenomena on Pd powder using β-emitting isotopes. The applicability of the method was presented in the case of the adsorption of ^{36}Cl labeled acetic acid. The potential dependence of the adsorption of Cl^- ions is discussed. (auth)

27104 DETERMINATION OF THE FIRST HYDROLYSIS CONSTANT OF EINSTEINIUM. Hussonnois, M.; Hubert, S.; Brillard, L.; Guillaumont, R. (Univ., Paris). Radiochem. Radioanal. Lett.; 15: No. 1, 47-56(20 Sep 1973). (In French).

The first hydrolysis constant, K_1, for Es(III) was determined simultaneously with those of trivalent Am, Cm and Cf. A break appears with Cm in variation of log K_1 versus Z. (auth)

27105 OXIDATION OF Bk(III) WITH OZONE IN A CARBONATE MEDIUM. Myasoedov, B. F.; Chepovoi, V. I.; Lebedev, I. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Let.; 15: No. 1, 39-45(20 Sep 1973).

The conditions of Bk(III) and Ce(III) coprecipitation with La carbonate in K_2CO_3 and $(NH_4)_2CO_3$ media were investigated. Optimal conditions of Bk(III) and Ce(III) oxidation to Bk(IV) and Ce(IV) by ozone, and of their separation from the +3 oxidation states were determined. In 0.5M K_2CO_3, Bk and Ce are fully oxidized by ozone to the +4 oxidation state. (auth)

27106 KINETICS AND MECHANISM OF THE DECOMPOSITION OF THE URANIUM(V) – CHROMIUM(III) COMPLEX AND OF ITS REACTION WITH EXCESS CHROMIUM(II). Ekstrom, A. (Australian Atomic Energy Commission, Sydney). Inorg. Chem.; 12: No. 10, 2455-2460(Oct 1973).

The kinetics of the decomposition of the U(V) · Cr(III) binuclear complex and of its reaction with excess Cr(II) were studied. The decomposition of the complex was found to be a first-order process under the experimental conditions used, the values of ΔH^* and ΔS^* being 12.8 ± 0.1 kcal mol^{-1} and –21.2 ± 0.4 eu, respectively. The rate was found to be virtually independent of acid concentration and ionic strength. The rate of reaction between U(V) Cr(III) and excess Cr(II) was also found to be independent of acid concentration but was strongly influenced by ionic strength, this effect being found consistent with the Debye–Huckel equation. For this reaction ΔH^* = 3.16 ± 0.30 kcal mol^{-1} and ΔS^* = –35.2 ± 1.0 eu. Reaction mechanisms consistent with the results are discussed. (auth)

27107 MECHANISM OF THE REDUCTION OF URANIUM(VI) BY TITANIUM(III) AND OF THE INDUCED REDUCTION OF VANADIUM(IV). Logan, T. P.; Birk, J. P. (Univ. of Pennsylvania, Philadelphia). Inorg. Chem.; 12: No. 10, 2464-2468(Oct 1973).

The reduction of uranium(VI) by titanium(III) in acidic chloride or perchlorate media was studied at 25.0°C and 0.500 M ionic strength. The reaction followed the rate equation $-d[U(VI)]/dt = k_1K_a[Ti(III)][U(VI)]/(K_a + [H^+])$ with K_a being the acid dissociation constant of Ti^{3+}. Values of the parameters were k_1K_a = 13.7 ± 0.5 sec^{-1} and K_a = 0.0136 ± 0.0035 M. The reaction is inhibited by vanadium(IV), according to the rate equation $-d[U(VI)]/dt = k_1k_2K_a^2k_3^{-1}[Ti(III)]^2[U(VI)](K_a + [H^+])^{-2}/\{[VO^{2+}] + k_2K_ak_3^{-1}[Ti(III)](K_a + [H^+])^{-1}\}$ with $k_1k_2K_a^2k_3^{-1}$ = 0.446 ± 0.014 M sec^{-1} and $k_2K_ak_3^{-1}$ = 0.0324 ± 0.0011 M. The inhibition is interpreted in terms of a competition for U(V) between V(IV) and Ti(III), which is verified by the observed production of V(III). (auth)

27108 PREPARATION OF SOLS BY HYDROGEN REDUCTION OF NITRATE SOLUTIONS. Smith, J. G. (to United States Atomic Energy Commission). U. S. Patent 3,748,273. 24 Jul 1973. Filed date 4 May 1971. 6p.

A method is presented for the production of sols of actinides, and related metals from their respective nitrate solutions, especially uranium dioxide sols. The process consists of converting metal nitrate solution into colloidal oxides by exposing the solution to hydrogen under pressure with vigorous stirring in the presence of a hydrogenation catalyst. (auth)

27109 INTERPRETATION OF LUMINESCENCE SPECTRA AND INFRARED SPECTRA OF EUROPIUM AND URANYL NITRATES. Babich, Ya. I.; Gur'ev, K. I.; Zolin, V. F.; Kovner, M. A.; Fisher, P. S.; Tsaryuk, V. I. Zh. Prikl. Spektrosk.; 19: No. 1, 158(Jul 1973). (In Russian).

Results of analyzing the structure of rare earth and actinide nitrates on the basis of Raman and infrared spectra do not coincide with the results of x-ray analysis. From data obtained from luminescent and infrared spectra of europium and uranyl nitrates, an analysis of the normal oscillations of these compounds is presented. The results of the analysis give evidence on the non-characteristicness of the oscillations of the nitrate groups. Since the intensity of the electron-oscillatory transitions, which are connected with the completely symmetrical oscillations, should be higher than the intensity of the other electron-oscillatory transitions, the distribution of intensities in the electron-oscillatory spectra of europium and uranyl nitrates may be used in establishing the type of coordination of the nitrate groups. (SJR)

27110 TRITIUM: PHYSICAL, CHEMICAL, AND RADIOLOGICAL DATA. Rebiffe, J. (Centre d'Etudes de Valduc, Is-sur-Tille, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 63-70 (Apr 1973). (In French).

The physical, chemical and radiological characteristics of tritium are presented. (FR)

27111 BIODEGRADABLE RADIOACTIVE POLYSACCHARIDE PARTICLES. Lindsay, T. W.; Kubiatowicz, D. O. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,758,678. 11 Sep 1973. Filed date 26 Sep 1968. 8p.

A method is reported for the preparation of substantially spherical particles having a smooth outer surface, consisting essentially of a solid, cold-water insoluble vehicle comprising a physiologically acceptable, parenterally metabolizable radioactive polysaccharide. The particles are substantially nonleachable on short-term exposure to cold water. The particles can be administered parenterally for diagnostic, prophylactic, or therapeutic purposes. On administration in this way, they are broken down or solubilized by the body fluids over a predeterminable period ranging from minutes to several days, whereupon the radioisotopic material is excreted from the body thus limiting exposure to the radiation. (Official Gazette)

27112 POTENTIOMETRIC STUDIES OF SOME BIVALENT METAL ION CHELATES OF N-ACETYLACETONEANTHRANILIC ACID. Mehta, R. K.; Gupta, R. K.; Singhi, V. C. (Univ. of Jodhpur, India). Z. Phys. Chem. (Leipzig); 253: No. 1/2, 49-52 (1973).

Protonation constants (log K_1^H and log K_2^H) of N-acetylacetoneanthranilic acid (abbr. H_2AA) and formation constants of certain of its bivalent metal complexes were determined potentiometrically in 50% dioxane (vol./vol.) solutions (μ = 0.1 m sodium perchlorate) at 30 ± 0.1°C. The stabilities of these complexes follow the order: UO_2 > Cu > Ni > Co > Zn > Cd. (auth)

27113 PREPARATION OF MEDICAL POTASSIUM CHLORIDE, LABELLED WITH ^{43}K. Toerko, J.; Szirtes, L. (MTA Izotop Intezete, Budapest). Izotoptechnika; 16: No. 7-8, 488-491(1973). (In Hungarian).

The separation of the reactor product ^{43}K from target material by cation exchange is described. The radionuclide purity of the end product is higher than 99.9%. (auth)

27114 LABELLING OF GORDOX WITH IODINE ISOTOPE AND ITS BIOLOGICAL FEATURES. Kutas, V. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest Izotoptechnika; 16: No. 7-8, 391-395 (1973). (In Hungarian).

A paper is presented on the labeling of this new Hungarian medicine and following its distribution in the organism. The highest dose is given to thyroid gland and kidneys. (auth)

27115 ^{113m}In–SMAA: NEW RADIOPHARMACON FOR LUNG SCINTIGRAPHY. Csetenyi, J.; Szentessyne, S. I.; Fuezy, M.; Karika, Z. (Orszagos Onkologiai Intezet, Budapest). Izotoptechnika; 16: No. 7-8, 401-405(1973). (In Hungarian).

The preparation of ^{113m}In–SMAA is described. The radiopharmaceutical is free from side-effects and is the most appropriate indium compound for lung scintigraphy. (DHM)

27116 PREPARATION AND ANALYTICAL CONTROL OF RADIOACTIVE METAL COMPLEXES OF DIAGNOSTIC VALUE. Pal, I. (Orszagos Gyogyszereszeti Intezet, Budapest); Jasz, A.; Kovach, A.; Kelemen, G. Izotoptechnika; 16: No. 7-8, 412-417 (1973). (In Hungarian).

The control of radiochemical purity by paper chromatography, electrophoresis and ion exchange was investigated. The last method proved to be the simplest and fastest, with the disadvantage of lowering the accuracy of the results. (auth)

27117 CHEMILUMINESCENCE STUDY OF THE OXIDATION OF U^{4+} BY HYDROGEN PEROXIDE. Shtol'ts, A. K.; Slepukhin, V. K.; Kovyazin, Yu. A.; Okunev, R. D.; Sal'manov, A. N. Tr. Ural. Politekh. Inst.; 193: 61-66(1971). (In Russian).

In experiments to find evidence of chemiluminescence of uranium, the conditions of U^{4+} oxidation by hydrogen peroxide were studied. At pH 2.9 and a temperature of 20°C, five times the stoichiometric amount of hydrogen peroxide gave the highest values of luminescence. The optimum pH was 2.5 to 3.0 with a U^{4+} concentration of 10^{-7} to 10^{-2} g/liter. The logarithm of the oxidation rate varied linearly with the logarithm of the U^{4+} concentration, and the intensity of the chemiluminescence as a function of the U^{4+} concentration was expressed by a simple relation so that the amount of U^{4+} present could be determined from the luminescence in the concentration range mentioned. The reaction rate increased with increasing temperature, but the dependence was not so simple as it was for the other factors. (TTT)

27118 STABILITY OF ^{131}I–THYROXINE AND ^{131}I–TRIIODOTHYRONINE AND THE INFLUENCE OF RADIOLYTIC DEGRADATION ON SOME DIAGNOSTIC TESTS. Reviczky, A.; Szanto, L. (Orszagos Reuma-es Fizioterapias Intezet, Budapest). Izotoptechnika; 16: No. 7-8, 378-386(1973). (In Hungarian).

The dependence of deiodization of thyroxine on the dielectric constant of the aqueous solvent and on time was studied. Results of the test are influenced by the place of labeling. Deiodization of triiodothyronine depends less on these factors. (auth)

27119 COMPARATIVE STUDY BY MOESSBAUER EMISSION SPECTROSCOPY OF THE AFTER-EFFECT OF THE ^{119m}Sn AND ^{57}Co DECAYS IN SELECTED COMPLEXES. Sanchez, J. P.; Llabador, Y.; Friedt, J. M. (Centre National de la Recherche Scientifique, Strasbourg). J. Inorg. Nucl. Chem.; 35: No. 10, 3557-3565(Oct 1973).

The reduced aliovalent state Sn(II) appears in the Mössbauer emission spectra of $^{119m}Sn:SnBr_4$, 2py (py = pyridine) and $SnBr_4$, bipy (bipy = $\alpha-\alpha'$ bipyridine). On the other hand, only the normal charge state is observed in the source spectra of $^{119m}Sn:SnCl_2$, bipy, $^{57}Co:CoCl_2$, npy (n = 6,4,2,1,⅔) and $^{57}Co:Co(bipy)_3(ClO_4)_2$. The results are discussed in terms of the autoradiolysis model. (auth)

27120 LIQUID ANION EXCHANGE OF THIOCYANATE–NITRATE ACTINIDE AND LANTHANIDE COMPLEXES. Chiarizia, R.; Danesi, P. R.; Scibona, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). J. Inorg. Nucl. Chem.; 35: No. 10, 3595-3604(Oct 1973).

The liquid-liquid biphasic chemistry of the system quaternary alkylammonium salt-o-xylene water-trivalent metal cation (actinide or lanthanide)-thiocyanate-nitrate anions was studied, to obtain both information on the aqueous complex formation constants of these elements and parametric equations useful to process chemistry design. The aqueous equilibrium constants between Eu^{+3}, Ce^{+3}, Cm^{+3}, Am^{+3}, Cf^{+3}, and SCN^- and NO_3^- were obtained at the constant ionic strength of 2.01 M and 25°C, by using a liquid anion exchanger (tricaprylmethylammonium thiocyanate in o-xylene). In the case of the SCN^- anion the actinide series shows a tendency to form complexes greater than the lanthanides, while this is approximately the same with the NO_3^- anion. For the actinide elements the tendency to form complexes is greater for SCN^- than for NO_3^-. As far as the technological applications are concerned the possibility of performing actinides–lanthanides separation appears promising. (auth)

27121 RELATIONSHIPS BETWEEN THE CHEMISTRY AND SPECTROSCOPY OF BISMUTH AND THAT ANTICIPATED FOR ELEMENT 115. Smith, G. P.; Davis, H. L. (Denmark Tekniske Hoejskole, Lyngby). Inorg. Nucl. Chem. Lett.; 9: No. 9, 991-996 (Sep 1973).

It is stated that calculations predict that the most stable oxidation state for element 115 (eka-bismuth) will be +1, but this is an unusual state for Group VA elements, and it has recently been suggested that there are virtually no possibilities of distinguishing the characteristics of element 115 ions and compounds from those of Bi. This communication calls attention to some possibilities that have been overlooked, and indicates studies that might be undertaken. At present ability to project the chemistry of Bi into convincing predictions about the chemistry of element 115 is severely limited by the small amount of data obtained so far on the lower oxidation states of Bi, and it would seem a good idea to make a closer experimental and theoretical study of the +1 and polycationic state of Bi as a preliminary guide to the identification and chemical isolation of element 115. (UK)

27122 EFFECT OF IMPURITIES OF OXIDATION OF U^{4+} BY HYDROGEN PEROXIDE IN CHEMILUMINESCENCE STUDIES. Shtol'ts, A. K.; Slepukhin, V. K.; Kovyazin, Yu. A.; Okunev, R. D.; Sal'manov, A. N. Tr. Ural. Politekh. Inst.; 193: 61-66(1971). (In Russian).

The effects of metallic ions and heavy water on the hydrogen peroxide oxidation of U^{4+} was studied, using the chemiluminescence produced as an indication of the reaction. With a U^{4+} concentration of 5.29×10^{-3} g/liter, H_2O_2 concentration of 2.64×10^{-4} g/liter, pH of 2.9, and temperature of 20°C, increasing the impurity content from 0 to 1.4×10^{-2} g for Pr^{3+}, Cu^{2+}, Gd^{3+}, or Mn^{2+} increased the rate of the chemiluminescence; a rare earth mixture (Ce^{3+}, Pr^{3+}, Gd^{3+}, Dy^{3+}) or Dy^{3+} alone decreased it; and Ho^{3+}, Nd^{3+}, or Ce^{3+} had no effect. The intensity of the chemiluminescence was generally decreased by an increase in all metal ions tested, although none of the curves were smooth; D_2O had no significant effect. The data are presented as graphs of contaminant concentration vs. intensity or rate. (TTT)

27123 FORMATION OF STABLE SALTS OF CATION FREE RADICALS BY URANIUM(V) COMPLEXES. Selbin, J.; Durrett, D. G.; Sherrill, H. J.; Newkome, G. R.; Collins, M. (Louisiana State Univ., Baton Rouge). J. Inorg. Nucl. Chem.; 35: No. 10, 3467-3480(Oct 1973).

Reaction of $UOCl_5^{2-}$ in CH_3NO_2 solution with phenazine (P) has produced a very stable cation free radical chloride salt, $\dot{P}H_2Cl$, which has been fully characterized by EPR and other methods. Other studies have permitted speculation that the mechanism of the reaction involves attachment to the UO^{3+} entity of both P and H_2O, followed by transfer to the P of both protons from the H_2O and lone 5f electron from U(V), yielding $\dot{P}H_2^+$ and $UO_2Cl_4^{3-} \cdot UOBr_5^{2-}$ yielded $\dot{P}H_2Br$. Analogously obtained were stable salts (either as Cl^- or as $UO_2Cl_4^{2-}$) of cation free radicals of benzo[a]phenazine, dibenzo[a, c]phenazine, 2,3-bis-(2-pyridyl)quinoxaline and acridine. Phenothiazine, which requires one electron oxidation to form a free radical, 1,3-dimethylalloxazine and 3,10-dimethylisoalloxazine all reacted with UCl_6^- to yield the cation free radical as the UCl_6^{2-} salt. This demonstrated that U(V) may serve either as a one-electron reducing agent in the form of $UOCl_5^{2-}$ (with H_2O present, yielding the very stable $UO_2Cl_4^{2-}$) or as a one-electron oxidizing agent in the form of UCl_5^- (no H_2O present, yielding the very stable UCl_6^{2-}). Because of the biological significance of many of the foregoing heterocycles that have yielded free radicals with U(V), the work is being extended to the biologically important metal molybdenum in its IV, V, and VI oxidation states. (auth)

27124 TRIGONAL AND ORTHORHOMBIC CRYSTAL STRUCTURES OF CfF_3 AND THEIR TEMPERATURE RELATIONSHIP. Stevenson, J. N.; Peterson, J. R. (Univ. of Tennessee, Knoxville). J. Inorg. Nucl. Chem.; 35: No. 10, 3481-3486(Oct 1973).

Californium trifluoride was found to exhibit the high-temperature LaF_3-type trigonal structure as well as the known low-temperature YF_3-type orthorhombic structure. Average, room-temperature lattice parameters determined for the trigonal structure are: $a_0 = 6.945 \pm 0.003$ Å; $c_0 = 7.101 \pm 0.002$ Å. Room-temperature lattice parameters for orthorhombic CfF_3 are: $a_0 = 6.653 \pm 0.003$ Å; $b_0 = 7.039 \pm 0.001$ Å; $c_0 = 4.393 \pm 0.003$ Å. These latter values are the average of results obtained by the present authors and other workers. The orthorhombic ⇌ trigonal transformations were studied via annealing and quenching techniques, but conditions for establishing the transition temperature were not attained. (auth)

27125 HISTORY OF TRITIUM. Libby, W. F. (Univ. of California, Los Angeles). pp 3-11 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The history of tritium is traced from one of the last experiments done by Lord Rutherford to consideration of present usage of tritium. (DHM)

27126 CERTAIN SUBJECTS OF GENERAL INTEREST ON TRITIUM HALF-LIFE AND NOMENCLATURE. Moghissi, A. A. (National Environmental Research Center, Las Vegas, NV). pp 28-29 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

27127 FORCED EXCHANGE OF TRITIATED WATER WITH CLAYS. Rabinowitz, D. D.; Holmes, C. R.; Gross, G. W. (New Mexico Inst. of Mining and Tech., Socorro). pp 471-485 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A study was made of forced change in specific and total activity of tritium in water during electrodialysis of 3 types of clays, 2 types of kaolite and illite. The loss in total activity with time differs strikingly for the 3 reference clays that were electrolysis under similar conditions. The total loss varies from almost 26% of the initial total activity for the Georgia kaolinite to less than the error of determination for the illite. In all cases the total tritium recovered from hydroxyl water was less than 600 pCi and accounts for only a small fraction of the tritium lost from the water. The release of tritium from the clay by digesting with HCl at 200°C indicates the existence of an exchange mechanism which is completely different from the hydroxyl exchange. The net total activity of tritium recovered could have been bound in one of two exchange positions in the clay (1) cation exchange positions; (2) lattice (octahedral) positions vacated by aluminum which, under electric field, had moved into exchange positions. There are indications that H–Al exchange takes place in a clay under electrodialysis. The findings of acid treatment together with the observed changes in tritium activity during the electrodialysis and the exchangeable aluminum tend to support the second alternative. (DHM)

27128 TRITIUM TRACERS IN BIOLOGY: FACTS OR FICTION. Evans, E. A. (Radiochemical Centre, Ltd., Amersham, Eng.). pp 659-675 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Physical properties of tritium are reviewed. It is pointed out that tritium and its compounds are widely used as tracers for hydrogen and carbon structures in biological research and some fundamental problems are discussed. The importance of knowing the specificity of labeling in the tracer compound and the stability of the tritium label under experimental conditions is stressed. Methods currently in use for the preparation of tritium compounds described include: isotope exchange reactions; chemical synthesis; and biochemical methods involving the use of enzymes for the conversion of substrates labeled either by exchange or chemical synthesis into more complex labeled compounds. Examples of each method are given. (39 references) (CH)

27129 TRITIUM-LABELING. A Review. Peng, C. T. (Univ. of California, San Francisco). pp 676-704 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A review is presented that considers mechanisms of several tritiation methods and their practical aspects, the stability of tritiated compounds, and tritium–hydrogen exchange for protein conformation studies. (DHM)

Radioactive Waste Treatment

Refer also to abstracts 27134 and 27237.

27130 (JAERI-M-5274) COMPRESSION TREATMENT OF LOW- AND INTERMEDIATE-LEVEL SOLID WASTES CONTAINING PLUTONIUM. Wadachi, Y.; Shigaki, Y. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 12p. (In Japanese). NTIS (U.S. Sales Only).

The compression treatment is planned for low- and intermediate-level solid wastes containing plutonium that are produced in amounts of about 20m^3 yearly in the plutonium handling facilities of Tokai Research Establishment. (auth)

27131 (ORNL-4790) USE OF EVAPORATION FOR THE TREATMENT OF LIQUIDS IN THE NUCLEAR INDUSTRY. Godbee, H. W. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 100p. Dep. NTIS $5.45.

A survey of evaporation as applied to radioactive waste solutions was made to evaluate the effectiveness of this unit operation as a treatment method for reducing releases of radioactive effluents to the environment from nuclear power plants. Some nuclear installations have experienced good results with evaporators—achieving decontamination factors of 10^4 to 10^6 from feed to overhead discharge. Others have experienced poor results—achieving decontamination factors of less than 10. Evaporators for radioactive waste vary from simple pots with steam heating pipes coiled inside to elaborate devices with pumps to circulate the feed through outside heaters and compressors for recompressing the vapor to increase its temperature and permit its reuse. Technical data collected include the type of evaporators used; the kinds of ancillary equipment employed such as mist separators, condensers, and preheaters; and the important operating parameters such as vapor velocity, boil-up rate, pressure or vacuum, etc. The results show that a system decontamination factor of 10^3 to 10^4 can be expected for nonvolatile radioactive contaminants treated in single-stage evaporators. Similar decontamination factors can be expected for ruthenium under alkaline, but not acidic and oxidizing, conditions. The decontamination factors for iodine can be expected to be a factor of 10 to 100 lower than those expected for nonvolatile species under alkaline, but not oxidizing or acidic, conditions. Decontamination factors are reduced by a factor of about 10 if organic materials are mixed with aqueous wastes. These values consider that the evaporator is well designed, adequately sized, and operated with reasonable skill. (auth)

27132 YIELDS OF TRITIUM DURING THE FISSIONING OF NUCLIDES OF INTEREST IN THE OPERATION OF NUCLEAR POWER REACTORS. Horrocks, D. L. (Argonne National Lab., IL). pp 30-37 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritium is produced from fission. The consequence of this can be useful and/or hazardous. It will be very important to the future of nuclear power sources to know the actual yield of tritium so that all precautions can be exercised to limit any harmful effects. It should also be remembered that there are other sources of tritium which are more productive than the fission process: neutrons on ^{6}Li and neutrons on deuterium. Very small amounts of lithium impurity can produce much more tritium than is produced by the fission process. (auth)

27133 TRITIUM PRODUCTION IN NUCLEAR REACTORS. Kouts, H. (Brookhaven National Lab., Upton, NY); Long, J. pp 38-45 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The rate of tritium production in nuclear power reactors is reviewed with respect to basic mechanisms and production in different types of reactors. Production from fuel reprocessing and in thermonuclear reactors is also considered. (DHM)

27134 ASSESSMENT OF RADIOLOGICAL HAZARDS FROM TRITIUM CONTAMINATED MATERIALS: AN APPROACH. Gupta, V. K. (Bhabha Atomic Research Centre, Bombay). pp 758-764 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Since tritium that has diffused into material diffuses out and becomes airborne, it is necessary to evolve a simple and fast technique to determine total tritium release from contaminated articles and to assess the radiological hazards present during shipment, inspection, and/or maintenance. An attempt was made to estimate total tritium release on the basis of smeared activity from the surface of the experimental specimen under normal ventilation conditions at room temperature. An empirical relationship correlating the smeared activity and the total tritium release is proposed. Derived permissible smear levels in terms of the surface area are given for mild steel, aluminum, polyethylene, and rubber. (DHM)

27135 DETERMINATION OF TRITIUM LEAK RATES FROM WASTE PROCESSING EQUIPMENT. Curtis, M. L.; Bishop, C. T.; Bolton, M. M.; Ryan, R. L. (Monsanto Research Corp., Miamisburg, OH). AT-33-1-GEN-53. pp 784-792 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Analytical techniques were developed for determining leak rates of 10^{-16} ml/sec and higher. The method involves sealing the canister, containing tritium wastes, in a methane atmosphere within an appropriate size container, the interior of which has been coated with cellulose acetate. After several days, the tritium which has leaked from the canister into the container is measured by β counting. (DHM)

27136 METHOD AND EQUIPMENT FOR THE TREATMENT OF INJURIOUS, PARTICULARLY RADIOACTIVE WASTES. Heitmann, H. G.; Putnawala, A.; Schaetzler, H. (to Kraftwerk Union AG). German Patent 2,135,328. 1 Feb 1973. 7p. (In German).

A procedure is presented for the solidification of radioactive or otherwise dangerous waste concentrates using binding agents. For this purpose the concentrate is mixed with the powder of one or more plastic materials and heat-treated, during which process the water evaporates and the plastic powder liquefies. The viscous liquid is then cooled down in a container and allowed to solidify. (GE)

27137 REMOVAL OF ORGANIC AND INORGANIC IODINE FROM A GASEOUS ATMOSPHERE. Cathers, G. I.; Shockley, W. E. (to United States Atomic Energy Commission). U. S. Patent 3,752,876. 14 Aug 1973. Filed date 26 Aug 1971. 4p.

A method of removing iodine from a gaseous atmosphere is provided which comprises contacting said iodine-containing atmosphere with a refluxing aqueous solution which is at least 15.3 M in nitric acid under such conditions as to avoid adverse volatilization of iodine. (auth)

Radioisotope Production

27138 (BNL-18018) MEDICAL APPLICATIONS DEVELOPMENT PROGRAM. Stang, L. G. Jr. (Brookhaven National Lab., Upton, N. Y.). Jan 1973. 53p. Dep. NTIS $4.75.

Programs at Brookhaven National Laboratory for radioisotope and radiopharmaceutical production are reviewed. Emphasis is placed on the use of a facility attached to the Brookhaven AGS synchrotron for the production of short-lived radionuclides for use in nuclear medicine. (CH)

27139 PROCEDURE FOR THE PREPARATION OF RADIOACTIVE MOLYBDENUM-99 FISSION PRODUCT. Arino, H.; Kramer, H. H.; McGovern, J. J.; Thornton, A. K. (to Union Carbide Co.). German Patent 2,231,976. 11 Jan 1973. 33p. (In German).

The described method deals with the preparation of high-purity ^{99}Mo with high specific activity. The initial irradiation material for the production of ^{99}Mo is uranium metal or uranium oxide, respectively, which is coated as a thin layer to the inner walls of a cylindrical stainless steel target. The chemical separation of ^{99}Mo from fission products and other activities consists of a series of precipitation, adsorption, and ion-exchange steps, which may be varied in a wide range depending on purity requirements. Molybdenum-99 with an activity of several hundred Curies can be achieved using less than 8 hours energy per separation procedure. (GE)

27140 RADIONUCLIDE GENERATOR AND A METHOD FOR ITS PRODUCTION. Brown, J. L.; Harris, O. A. (to Mallinckrodt Chemical Works). German Patent 2,242,395. 15 Mar 1973. 25p. (In German).

The radionuclide-generator method for the production of sterile, pyrogen-free ^{99m}Tc pertechnetate, produces an eluate essentially free from aluminium ions (from the chromatographic column) and is especially useful for the preparation of Tc-S colloids. (GE)

27141 SEPARATION OF AMERICIUM AND CURIUM. Mason, G. W.; Bollmeier, A. F. Jr.; Peppard, D. F. (to United States Atomic Energy Commission). U. S. Patent 3,743,696. 3 Jul 1973. Filed date 4 Feb 1971. 6p.

A process is described for the quantitative separation of americium values from curium values and from other trivalent actinide and lanthanide values contained in a nitric acid feed solution by selectively oxidizing the americium to a higher valence state and extracting the oxidized americium with bis(2,6-dimethyl-4-heptyl) phosphoric acid while the trivalent values remain in the feed solution. (auth)

27142 SEPARATION OF CARRIER-FREE ^{72}Se FROM A GERMANIUM OXIDE TARGET. Mudrova, B.; Kopecky, P.; Svoboda, K. (Ustav Joderneho Vyzkumu, Rez, Czech.). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 610-612(Oct. 1973).

The production of ^{72}Se is of growing importance due to the use of ^{72}Se–^{72}As generator systems for medical use. Since ^{72}Se can be produced by the reactions ^{70}Ge(α,2n)^{72}Se and ^{70}Ge(^{3}He,n)^{72}Se the chemical separation of selenium from germanium and arsenic is of primary importance. For this purpose a rapid and highly specific separation method based on the formation of selenium(IV) ketone-chloro complexes in a hydrochloric acid medium which are soluble in some organic solvents has been tested and adapted. The application of the reaction of selenium(IV) with some ketones to the solvent extraction separation and spectrophotometric determination of selenium has recently been examined by several authors. The aim of the present work was to search for the most suitable ketone, to determine the optimum experimental conditions for the separation of selenium from the dissolved target material and the best method for a complete decomposition of the organoselenium compounds used. The recommended procedure is given. (UK)

27143 OXYGEN AND HYDROGEN ISOTOPE RATIOS IN CHERTS AND RELATED ROCKS. Knauth, L. P. Pasadena, CA; California Inst. of Tech. (1973). 379p. University Microfilms Order No. 73-18,374.

Thesis (Ph. D.).

The feasibility of making meaningful measurements of the deuterium content of water extracted from hydrous silica was evaluated by a series of dehydration and isotope exchange experiments. A new experimental technique, called Differential Isotopic Analysis (D.I.A.), was developed which allows the isotopic exchange characteristics of water in different sites in hydrous silica to be determined. This method involves the sampling of successive increments of water driven off during heating of the silica and the measurement of δD for these water samples. The isotopic pattern established for the δD-values of successively driven-off samples varies markedly, depending on the degree to which the water in silica has been exchanged with deuterium-rich water in controlled experiments. The fraction of the water or hydroxyl groups that is most resistant to exchange and most difficult to drive off is that water or hydroxyl group most likely to contain the hydrogen which was in equilibrium with the waters from which the silica formed. Granular microcrystalline quartz, the most common constituent of chert, has been found to contain hydroxyl groups particularly suitable for hydrogen isotope analyses. Cherts of a given age consisting of granular microcrystalline quartz free of organic matter yield an approximate linear relationship between δD and δ^{18}O of the total oxygen. The line thus defined is parallel to the δD–δ^{18}O relationship for meteoric waters, but has an intercept which is age-dependent. The isotope data indicate that, for many cherts, the diagenetic transformation of opal to granular microcrystalline quartz occurred in the presence of meteoric waters. The displacement with time of the δD–δ^{18}O relationship is interpreted as being due to the effect of past climatic temperature changes on the temperature-dependent isotopic fractionation factors for D/H and ^{18}O/^{16}O. The variations in ^{18}O/^{16}O and D/H ratios of cherts and other forms of hydrous silica have been investigated and have been used to deduce climatic temperature variations for the central and western United States over geologic time. Temperatures deduced for chert formation indicate that the average past climatic temperatures for the central and western United States decreased from 34°C to 20°C through the Paleozoic, increased to 35° to 40°C in the Triassic, and then decreased to the present day value of 13° to 15°C. Temperatures in the Precambrian for this region may have reached over 50°C at 1.3 billion years, although temperatures similar to those of the Phanerozoic Era are inferred at 2 billion years and 1.2 billion years. Extremely cold temperatures deduced for deep ocean water from the oxygen isotopic composition of several samples of opal–CT (1.2 wt % H_2O) in deep sea sediments indicates the possibility of ice caps at the close of the Cretaceous and at the beginning of the Oligocene. Granular microcrystalline quartz in deep sea sediments often forms during deep burial at elevated temperatures and cannot be used to deduce deep ocean temperatures. (Diss. Abstr.)

Reactor Fuel Reprocessing

Refer also to abstracts 27172, 27222, 27801, 27807, 27932, 27935, and 29166.

27144 (CONF-730927-1) CHEMICAL REPROCESSING OF NUCLEAR FUEL. Ferguson, D. E. (Oak Ridge National Lab., Tenn.). 1973. 21p. Dep. NTIS $3.25.

From 24th congress of the international union of pure and applied chemistry; Hamburg, F. R. Germany (3 Sep 1973).

The status of the present nuclear fuel reprocessing industry is described. Developmental work and plans are also considered for future reactor fuels including the LMFBR. The Midwest Fuel Recovery Plant, owned and operated by the General Electric Company, is described as an example of a modern processing plant.

This is followed by a review of the forecasted growth of the reprocessing industry; methods for control of radioactive effluents; and, finally, management of radioactive wastes. (auth)

27145 FLUORIDE REPROCESSING OF BREEDER FUELS. Anastasia, L. J.; Carls, E. L.; Chilenskas, A. A.; Grane, J. E. A.; Jonke, A. A.; Levitz, N. M.; Steindler, M. J.; Trevorrow, L. V. E. (to United States Atomic Energy Commission). U. S. Patent 3,753,920. 21 Aug 1973. Filed date 24 Oct 1968. 14p.

Spent fuel oxides are fluorinated to produce a plutonium-rich stream and a uranium-rich stream. Each stream is cold trapped to remove high boiling fission products and fed to a thermal decomposer, via a common feed pot which acts as a batch distiller. From the thermal decomposer, a plutonium-rich stream is cold trapped and sent to a converter and a uranium-rich stream is purified by means of various traps and distillation columns and sent to the converter. In the converter, the uranium-rich stream and plutonium-rich stream are combined and converted to mixed oxides. (auth)

27146 QUANTITATIVE RECOVERY OF KRYPTON FROM GAS MIXTURES MAINLY COMPRISING CARBON DIOXIDE. Ferguson, D. E.; Haas, P. A.; Leuze, R. E. (to United States Atomic Energy Commission). U. S. Patent 3,742,720. 3 Jul 1973. Filed date 25 Jul 1972. 10p.

A continuous process is described for the quantitative recovery of krypton from a feed gas mainly comprising carbon dioxide and also containing minor percentages of oxygen and nitrogen, as well as trace quantities of krypton. The process includes three principal separations: absorption of krypton from the feed gas to provide a krypton-decontaminated waste gas; fractionation of the gases co-absorbed with the krypton; and stripping of the krypton from the absorbent to provide (a) krypton-free carbon dioxide for use as the process absorbent and (b) krypton-enriched liquid product. The carbon dioxide absorbent is derived from the feed gas itself. (auth)

27147 EXTRACTION OF URANIUM FROM AN AQUEOUS SOLUTION. Peppard, D. F.; Mason, G. W.; Bollmeier, A. F. Jr.; Lewey, S. (to United States Atomic Energy Commission). U. S. Patent 3,745,205. 10 Jul 1973. Filed date 17 Feb 1972. 6p.

Uranium values are separated from the lanthanides, actinides, and yttrium values in a +3 valence state and from thorium values by dissolving the values in hydrochloric acid to prepare a feed solution. The feed solution is contacted with an organic extractant of bis(2,6-dimethyl-4-heptyl) phosphoric acid in an organic diluent whereby the uranium values are selectively extracted and the other values remain in the feed solution. (auth)

27148 FUEL REPROCESSING. pp 290-298 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Topics considered are: description of the fuel reprocessing industry in the U. S., sources of radioactive emissions, and experience with commercially operated plants. (DHM)

27149 DISSOLUTION PROCESS FOR THORIUM-CONTAINING NUCLEAR FUELS WITH REDUCED WASTE PRODUCTION. Wojtech, B. (Farbwerke Hoechst AG, Frankfurt am Main). Chem. Ing.-Tech.; 45: No. 16, 1022-1025(1973). (In German).

Replacement of aluminium nitrate by thorium nitrate in Thorex reagent as solvent for thorium-containing nuclear fuels leads not only to a considerable reduction in waste material during reprocessing but also to a shortening of the dissolution time. The most favourable composition of the solvent was determined and various measures and processing modes for acceleration of dissolution were studied. In addition to grinding the fuel particles, the Heel technique is particularly recommended for batch dissolution, and countercurrent operation in a tube for continuous dissolution. Dissolution times amount to $\frac{1}{10}$ or less of those required in conventional processes. Use of pure titanium in the construction of the dissolver provides a satisfactory solution to corrosion problems. (auth)

27150 PROCESS AND APPARATUS FOR THE RECOVERY OF NUCLEAR FUEL MATERIAL FROM FUEL ELEMENTS OF GRAPHITE MODERATED HIGH TEMPERATURE REACTORS. Tillessen, U.; Engel, K. H.; Pirk, H.; Hackstein, K. G.; Habermann, D. (to Nuken, Nuklear-Chemie und- Metallurgie Gesellschaft mbH). US Patent 3,756,786. 4 Sep 1973. Priority date 5 Dec 1969, F. R. Germany. 8p.

The invention is concerned with a new shaft furnace process for burning the fuel element graphite used in gas-cooled high temperature reactors as moderator as well as structural and coating materials. Nuclear fuel elements containing a graphite moderator are reworked by burning the unground fuel element carbon in a two-step fixed bed process with oxygen. The structural and matrix graphite are burned in a first step at 800°C to 1100°C, and the pyrolytic carbon is burned in a second step at a lower temperature of 600°C to 900°C. A shaft furnace for performing the process is also described. (Official Gazette)

27151 METHOD FOR SEPARATING PARTICLES. Langer, S. (to Gulf Oil Corp.). U. S. Patent 3,755,074. 28 Aug 1973. Filed date 25 Apr 1968. 10p.

A method is reported for fueling nuclear reactors and thereafter separating groups of irradiated fuel prior to reprocessing of the groups. The method includes forming at least two groups of nuclear fuel particles. At least one of the groups is then coated with pyrocarbon while the remaining groups of particles are coated with material which includes a layer of silicon carbide. The coated groups of particles are then mixed with graphite and a graphite matrix fuel body is formed. A nuclear reactor is fueled with the fuel body and the fuel body is removed from the reactor after being irradiated. The fuel body is then exposed to oxidizing conditions sufficient to oxidize the graphite matrix and the pyrocarbon coating of one group without oxidizing the silicon carbide layer of the other groups. The intact silicon carbide groups of particles are then separated from the other groups of particles for reprocessing apart from the other groups of particles. (Official Gazette)

27152 GENERAL DESIGN CRITERIA GUIDE FOR NUCLEAR FUEL REPROCESSING FACILITIES. Revision 3. New York; American Institute of Chemical Engineers (1971). 17p. (ANSI-N101.3). American National Standards Institute, New York.

A standard is presented that provides the general design criteria for nuclear fuel reprocessing facilities. The principal design criteria must provide assurance that facility design encompasses features required for the protection of plant personnel and the public in the areas of health and safety, including consideration of site and environmental conditions. The standard is intended to be used as a guide, allowing for additions or deletions shown to be equivalent in intent. The principal design criteria for the facility contains the essential requirements of the design and quality assurance for the facility structures, systems and components, including protection against natural phenomena and credible incidents. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 27568, 27750, 27794, 28996, and 29415.

27153 (AD-740572) RESEARCH ON NONEQUILIBRIUM MHD GENERATORS. Annual Technical Progress Report, 1 February–31 December 1970. Kerrebrock, J. L. (Massachusetts Inst. of Tech., Cambridge). Jul 1971. Contract F33615-69-C-1226. 53p. (AFAPL-TR-71-45). NTIS.

Progress in a study of nonequilibrium generator is presented, with emphasis on the vibrational excitation of molecular species. Experimental work on a large generator includes development of a coaxial preionizer and development of slanted electrode walls, both of which increase the power density of the generator. A three-dimensional analysis of the slanted electrode wall is also given. Finally preliminary, experimental and theoretical work on the effect of an intense radiation field, coupled to the molecules, on electrothermal instabilities is reported. (auth)

27154 MHD LIQUID METAL JET GENERATOR. Breev, V. V.; Dmitriev, K. I.; Ulinich, F. R. Magn. Gidrodin.; No. 2, 151-153(1973). (In Russian).

The results of a theoretical and experimental study of an MHD jet generator were examined. In the one-dimensional approximation the problem of the optimum efficiency of the generator was solved. The optimum distribution of the magnetic field along the generator under different regimes was determined. Special problems were solved. Experiments on the constancy and linear increase of the magnetic field along the generator were reported. The limits of the stable operation of the jet generator were determined for both forms of the magnetic field. (tr-auth)

27155 RADIOISOTOPIC GENERATOR. Merges, V. (to Messerschmitt-Bolkow-Blohm Gesellschaft Mit Beschrankter Haftung). US Patent 3,754,999. 28 Aug 1973. Priority date 23 Nov 1968, P. R. Germany. 6p.

A radioisotopic or radionuclide generator is described which comprises a radioisotope as a heat source and sealed within a thin-walled metal cylinder. Thermoelectric energy converters are arranged in heat transfer relation with the metal cylinder, and a thermal insulation surrounds the metal cylinder and the energy converters. The heat source, the energy converters, and the thermal insulation are sealed within a thick-walled metal safety capsule whose exterior surface may be provided with a coat of depleted uranium to absorb gamma rays. The thick-walled sealing capsule has a central cylindrical portion and two hemispheric end portions welded or otherwise integral with the central cylindrical portion. The hemispheric ends of the capsule are designed as heat bridges for the energy converters. The thermal insulation is in the form of a cylinder whose mid-portion comprises a plurality of thin radially spaced metal foils of high thermal reflecting power, the spaces between the metal foils being highly evacuated. The end portions of the heat insulating cylinder comprise fibrous heat-insulating material, such as quartz cotton wool. (Official Gazette)

27156 METHOD FOR PREPARING SOLAR CELLS. Whigham, D. M.; Amsterdam, M. F. (to Westinghouse Electric Corp.). U. S. Patent 3,758,348. 11 Sep 1973. Filed date 13 Aug 1970. 6p.

A process for making a solar cell is described. Material for the solar cell is deposited on the substrate. A wraparound electrical contact shunts or short circuits any p-n junction formed between the deposited material and the substrate but not the p-n junction within the deposited material. The wraparound electrical contact is alloyed to the substrate and to the deposited material at the same time that a diffusion is being carried out in the deposited material to form a p-n junction therein. (Official Gazette)

27157 THERMOELECTRIC GENERATOR. Falkenberg, D.; Renner, T.; Rittmayer, G.; Winkler, J. (to Siemens Aktiengesellschaft). U. S. Patent 3,758,346. 11 Sep 1973. Priority date 17 May 1971, F.R. Germany. 8p.

A thermoelectric generator for supplying current for heart pacemakers is disclosed. The thermoelectric generator has a radioactive heat source and a plurality of thermocouple elements formed using microfilm technology. The container of the isotope heat source is arranged between two thermocouple units having thin-film thermocouple elements. These elements are evaporated onto a foil of plastic which is coiled up to form a hollow cylinder. The container is configured as a body of rotational symmetry and is fixed between the ends of the thermocouple units. The thermoelectric generator affords the advantages of low structural height and high efficiency. (Official Gazette)

27158 MULTIPARAMETER OPTIMIZATION OF A THERMIONIC FUEL CELL. Broval'skii, Yu. A.; Sinyavskii, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 9, 1530-1534(Mar 1973). Translated from Zh. Tekh. Fiz.; 42: No. 9, 1909-1914(Sep 1972).

A multiparameter optimization is carried out by a random-search method for a thermionic fuel cell. The goal function is an expression for the volume electric power density and the restriction is the criticality condition. The length, diameter, and thickness of the electrodes, the insulation, the cross-sectional area of the connecting neck, the composition of components in the core, and the potential difference are optimized. In a discussion of the results of the optimization, a tendency is found toward a miniaturization of the thermionic cell. (auth)

27159 STUDY ON THE STRUCTURE OF A THERMOMAGNETIC MOTOR AND ITS CHARACTERISTICS. Murakami, K.; Nemoto, M.; Mizutani, S. Rep. Res. Inst. Elec. Commun., Tohoku Univ.; 24: No. 3-4, 125-137(1972).

The thermomagnetic motor is the apparatus for converting thermal energy directly to mechanical energy by the use of the low Curie temperature cores. The experiments and the considerations on the behavior of a new thermomagnetic motor constructed by the authors are described and the mechanism of the thermal-mechanical energy conversion clarified. The load characteristics were measured. The mechanical output and the efficiency of this motor are of extremely low value because of the lack of suitable magnetic materials with low Curie temperatures. As a result of these experiments and consideration, it was concluded that such a motor can be used as a new control device in cooperation with the development of low Curie temperature cores in future. (auth)

27160 HIGH TEMPERATURE REGENERATIVE HEAT EXCHANGERS FOR OPEN CYCLE MHD POWER PLANT. II. Imatake, T.; Maita, Y.; Matsubara, S.; Irino, M. (Mitsubishi Heavy Industries, Ltd., Kobe, Japan). Mitsubishi Juko Giho; 10: No. 3, 400-408(May 1973). (In Japanese).

The MHD power plant is now expected to serve as a high-efficiency and low-pollution power plant. Previously, a schematic diagram of the MHD (coupled with a steam plant) was presented, and the performance of the valve switching stationary heat exchanger with pebble beds was described. Here, the characteristics of the rotary heat exchanger with perforated brick beds are reported, and the heat storage materials for these high-temperature heat exchangers are summarized. (auth)

Facilities and Equipment

Refer also to abstracts 27131, 27689, 29052, 29396, 29464–29467, 29541, 29544–29545, 29548, 29549, and 29567.

27161 SAMPLE IRRADIATION DEVICE. Russian Patent 280,709. 21 Oct 1968. (In Russian).

A device for the irradiation of samples in a cyclotron for activation analysis is described. The device consists of a body with a vacuum valve, a shaft with the sample carrier fixed on a pivoting head walled in by a transmission system that one can make vacuum-tight and cooled by a flow of coolant, e.g., water, distinguished by the fact that for the purpose of simultaneously irradiating in vacuum a large number of samples under like conditions the shaft with the pivoting head is made in the form of a cylinder with thin lateral walls that are easily deformed under pressure of the lateral water flow. The sample holder is made in the form of a cylinder. (TSS)

27162 APPLICATION OF FINITE ELEMENT METHOD TO AXISYMMETRIC BUCKLING OF SHALLOW SPHERICAL SHELLS UNDER EXTERNAL PRESSURE. Kikuchi, F.; Ohya, H.; Ando, Y. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 339-347(Jun 1973).

The finite element method is applied to the axisymmetric buckling of shallow spherical shells under uniform external pressure. In order to analyze the nonlinear behavior of shells with sufficient accuracy and efficiency, the simple load incremental method is modified by introducing the mid-increment stiffness matrix and residual load correction. The analysis is performed on a fairly wide range of the geometric parameter α to obtain pressure-deflection curves in both pre- and post-buckling states. The results appear generally satisfactory, at least up to the early

stage of post-buckling. In particular, the upper and lower buckling pressures are obtained in excellent agreement with known analytical solutions. (auth)

27163 APPLICATION OF FRACTURE MECHANICS TO PRESTRESSED CONCRETE PRESSURE VESSELS. Carmichael, G. D. T.; Jerram, K. (Central Electricity Generating Board, Berkeley, Eng.). (1973). vp.

From 3rd international congress on fracture; Munich, Germany (8 Apr 1973).

It is shown that the pseudo fracture toughness approach can be used for predicting fracture of concrete and mortars where cracks or crack-like defects exist. When combined with the crack closure work concept, the pseudo fracture toughness approach enables the approximate extent of cracking in PCPV's to be ascertained. The criterion is applicable to ultimate analysis, proof pressure test evaluations and to the examination of the tensile regions generated through stress re-distribution caused by creep. (GE)

Heat Transfer and Fluid Flow

Refer also to abstracts 27160, 27196, 29231, 29232, 29247, 29264, 29417, and 29552.

27164 (CEA-R-4457) METROLOGY OF TWO-PHASE FLOW: DIFFERENT METHODS. Delhaye, J. M.; Galaup, J. P.; Reocreux, M.; Ricque, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1973. 112p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Some global and local methods are described, which are used in two-phase flow in order to measure the void fraction, velocities and temperatures of both phases. Absorption methods, electromagnetic flowmeters, constant-temperature anemometry, resistive probes, microthermocouples, optical probes, sampling methods, and Pitot tubes are discussed. (auth)

27165 (IAE-2204) CALCULATION OF THE CRITICAL HEAT FLUXES IN ROD BUNDLES. Osmachkin, V. S.; Lystsova, N. N. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 12p. (In Russian). INIS.

A brief review is given of the most common method of the calculation of the crisis conditions of heat exchange in rod bundles, characteristic for reactors cooled by pressurized water. A new modification was given of the formula for calculation of the critical heat load in uniformly heated bundles in the range of high pressures (40 to 80 atm) and small steam content. (tr-auth)

27166 EXPANDING THE CAPABILITY OF A LABORATORY ULTRASONIC TESTING FACILITY. Moyer, M. W.; Gray, D. H. (Union Carbide Corp., Oak Ridge, TN). Mater. Eval.; 31: No. 10, 193-198(Oct 1973).

A remotely located, medium-size, multiuser computer has been interfaced to a general purpose ultrasonic testing facility to accumulate, analyze, and manipulate data, and plot the results in a matter of minutes. Data may be taken on flat plates and products of revolution. Up to four axes of transducer motion may be controlled in order to scan complex geometries. The rf waveform can be digitized and sent to the computer for Fourier analysis. In addition, individual points such as those generated by a standard may be stored. Analysis routines include determination of data which exceeds fixed thresholds, scaling of data to a calibration curve, determination of peak signals when scanning over flaws, integration of data over fixed lengths to smooth "noise," and Fourier analysts of rf waveforms. The expanded capability of the system gives the experimenter new tools with which to study NDT problems. (auth)

27167 GAMMA 2: A γ-RAY APPARATUS FOR VOID FRACTION MEASUREMENT. Fiegna, G.; Impavido, P.; Lavagno, E. (Politecnico, Turin). Termotecnica (Milan); 27: No. 7, 383-395 (Jul 1973). (In Italian).

From 27th national ATI congress; Naples, Italy (Sep 1972).

The void fraction in a two-phase flow can be evaluated by an experimental technique based upon the gamma-ray attenuation across the channel in which the two-phase mixture is flowing. On the basis of this technique, a gamma-ray apparatus to operate in connection with the 400 kW test loop existing in the Politecnico di Torino was developed. The thulium-170 source, collimators, and detector are supported by a mechanical device, by which their position can be varied. Movement control, preset for measuring local void fractions, and beam centering on the axis of the channel are performed by a single electronic device. The test loop, data correlations, mechanical and electronic equipment, and counting rate system are described. (auth)

27168 EXPERIMENTAL STUDY OF THE STIRRED LIQUID MOTION IN TWO-PHASE TWO-COMPONENTS CO-CURRENT FLUIDS. Lorenzi, A.; Pisoni, C. (Univ., Genoa). Termotecnica (Milan); 27: No. 7, 350-354(Jul 1973). (In Italian).

From 27th national ATI congress; Naples, Italy (Sep 1972).

Results are presented of an experimental investigation conducted on two-phase, two-component (water and air) fluids in vertical co-current flow. Test tubes of annular and circular cross-section were used. The most significant variables involved were measured at different values of air and water flow-rate, which could be regulated independently. In particular, the distribution and the average values of the liquid fluctuating velocity in the cross-section during air bubbling under different test conditions are given. (auth)

27169 CALCULATION OF COMPRESSIBLE FRICTION-FLOW IN PIPES WITH THE HELP OF A DIGITAL COMPUTER PROGRAM. Brosche, D. (Technische Univ., Munich). Brennst, Waerme-Kraft; 25: No. 8, 312-316(1973). (In German).

The calculation of mass flows of compressible, one-dimensional, subcritical and critical, one-phase friction-flows which may consist of any number of components and which occur in the field of reactor safety is discussed. For this purpose, the basic fluiddynamic equations were integrated analytically, resulting in relatively simple relations for various flow variables which can be used to obtain the required mass flows by iteration with the help of a digital computer program (Leiteu). The results of the calculation were checked by corresponding experiments whereby a very good agreement was found between theory and experiments. (GE)

27170 VOID FRACTION AND PRESSURE DROP IN LIQUID METAL TWO PHASE FLOW. Serizawa, A.; Michiyoshi, I. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 435-445(Jul 1973).

A new correlation is described for predicting a two-phase frictional pressure drop multiplier, and the pressure level and the mass velocity effects are discussed. This correlation predicts satisfactorily the frictional pressure drop not only for liquid metals but also for ordinary fluid two-phase flow in a wide range of flow variables. A void fraction correlation previously proposed is also compared with published data of void fraction for liquid metal two-phase flow, and is found to accurately represent the mass velocity effects. Wettability and magnetohydrodynamic effects are discussed briefly in relation to the hydrodynamic characteristics of liquid metal two-phase flow. (auth)

Materials Testing

Refer also to abstracts 27535, 27589, 27747, 27889, 29460, and 29463.

27171 (BMBW-At-T-5011-68) COMPARISON OF TEST METHODS FOR THIN-SHEET ZIRCALOY WELDS IN NUCLEAR ENGINEERING. Eggers, H. (Bundesministerium fuer Bildung und Wissenschaft, Bonn (West Germany)). Dec 1971. 117p. (In German). INIS.

Zircaloy-2 and -4 welds connecting tubes, or tubes and plugs, (outer diameter 11.7 mm, wall thickness 0.6 mm) were examined by destructive and nondestructive methods. The applicability and results of these methods were compared with one another. The results were as follows: faults in the welds between tubes can be ascertained with greater certainty than in the tube/plug welds; there are no differences in testing Zy-2 or -4 welds; as no test method indicates the faults with sufficient reliability, several methods must be applied simultaneously; and in addition to the usually employed test methods, the analysis of the weld current curve should be carried out which will yield some relevant information about the quality of the weld. (GE)

27172 (EUR-5015) IN-CELL CONTACT MICRO RADIOGRAPHY. Drago, A.; Huber, W. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). Jun 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25. EUR B.Fr. 40,-.

Contact microradiography is a powerful means to examine HTGR monolayer and coated particle fuels nondestructively. A successful effort was made at Petten to perform contact microradiography in post-irradiation analysis. (auth)

27173 (UCID-16324) ANALYSIS OF PULSED EDDY CURRENT TESTING. Taylor, G. M. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Aug 1973. Contract W-7405-eng-48. 19p. Dep. NTIS $3.00.

The application of two analytical models to a pulsed eddy current inspection problem is described. In the first method, the pulse is represented by its Fourier series, the system response is calculated for each frequency using values for the effective

self-inductance and resistance data obtained by measurements with a precision bridge, and the output pulse is reconstructed by adding these computed values of output. The second method represents the system by a transient dc analysis where "lumped" parameters are used. The nature of the solutions is described and some graphical results are included. (auth)

27174 ACOUSTIC EMISSION AND FRACTURE MECHANICS TESTING OF METALS AND COMPOSITES. Tetelman, A. S. (Univ. of California, Los Angeles). pp 1-46 of U. S.–Japan Joint Symposium on Acoustic Emission. Tokyo; Japan Industrial Planning Association (1972).

From U. S.–Japan joint symposium on acoustic emission; Tokyo, Japan (4 Jul 1972).

One of the most promising areas for application of acoustic emission testing lies in the characterization of microscopic processes of yielding and fracture, and macroscopic processes of slow crack growth and onset of fast crack propagation. These processes are described and it is emphasized that the total counts and count rate depend on the energy released per event and the density of events per unit of deformation. The models presented herein are first order approximations which await confirmation. (auth)

27175 REAL-TIME X-RAY INSPECTION SYSTEM FOR FAST FLUX TEST FACILITY FUEL. Jackson, C. N. Jr.; Gray, W. H.; Shaw, C. B. (Hanford Engineering Development Lab., Richland, WA). Mater. Eval.; 31: No. 10, 199-204(Oct 1973).

A real-time inspection system has been developed at HEDL for rapid and thorough x-ray inspection of FFTF fuel pins. This system consists of an x-ray generating unit and an x-ray sensitive vidicon camera closed-circuit video system contained within a shielded test chamber that is fully described. A special x-ray sensitive television camera is used in place of conventional film radiography. The camera employs an x-ray sensitive PbO signal plate. The x-ray unit features a new constant potential 260 kV x-ray tube with both a beryllium window and a 0.5 mm^2 focal spot size for obtaining an intense, high resolution x-ray beam. A test object is translated or rotated through the x-ray beam on a precisely guided test bed. Either dynamic or static parallax-free inspection of fuel pin internal components can be made. The vidicon camera and TV monitor provide high contrast and high image resolution capability. The 14-in. closed-circuit TV monitor with a magnification factor of 24X facilitates operator viewing at scan rates up to 12 in. minute. Precise dimensional measurements of fuel pin length and pellet-to-pellet interspace can be obtained with an accuracy of ±0.001 in. Photographs of typical monitor images and future development areas are also discussed. (auth)

27176 TECHNIQUE FOR PLACING KNOWN DEFECTS IN WELDMENTS. Landolt, J. F. (Dow Chemical Co., Golden, CO). Mater. Eval.; 31: No. 10, 214-216(Oct 1973).

A procedure was developed to simulate the type of defects normally found in welds. Quartz glass was used to form the defects in the weld. The glass is formed into a desired shape and placed in the weld joint. When the weld is completed, the glass remains intact producing a low density area that can be used as an indication of a defect condition. This defect can be used as a "standard" or calibration reference for nondestructive evaluations of the conditions of similar welds. (auth)

27177 EXPOSURE COMPENSATING DEVICE FOR RADIOGRAPHIC APPARATUS. Edholm, P.; Jacobson, N. B. (to Medinova AB). US Patent 3,755,672. 28 Aug 1973. Priority date 30 Nov 1970, Sweden. 20p.

A device for radiographic equipment is described for compensating for the variations in thickness, density and absorption properties in different parts of an object being radiographed so as to produce a more uniform average exposure of the radiographic recording medium and thereby a more uniform image contrast in all parts of the radiograph of the object. The device comprises a compensating filter device inserted in the radiation path between the radiation source and the object and including radiation absorbing means, which has a variable shape or form such that its absorption values within different portions of the radiation beam can be varied substantially independently of each other. The shape of this radiation absorbing means is varied by automatically operating control means in response to output signals from radiation detecting means disposed on the opposite side of the object so as to sense the average intensity values in different sections of the radiation beam leaving the object to be radiographed. (Official Gazette)

27178 DEVICE FOR DETECTING FLAWS ON NUCLEAR REACTOR INNER SURFACES AND INTERNALS. Bukrinskii, A. M.; Gladkov, J. K.; Kazakov, V. A.; Maximov, L. P.; Khmelnitskii, V. A.; Habanov, N. N. US Patent 3,756,915. 4 Sep 1973. Priority date 25 Jan 1971, USSR. 4p.

A device is described for detecting flaws on nuclear reactor inner surfaces and internals, wherein an inspection chamber with at least one inspection window moves about inside the reactor with the help of a means for positioning the inspection chamber. The chamber is connected with said means via a support element mounted above the reactor such that the chamber can rotate about and move along the vertical axis of the reactor. (Official Gazette)

27179 CELL FOR MEASURING STRESSES IN PRESTRESSED CONCRETE. Callahan, J. C. (to United States Atomic Energy Commission). U. S. Patent 3,742,757. 3 Jul 1973. Filed date 18 Oct 1972. 4p.

A compact embedment device is described for determining changes of stress in prestressed concrete structures. Stress forces are applied to opposite sides of the cell whereby a deflection of an internal member is proportional to the stress. Any changes are detected by variations in the output of strain gages attached to the internal member. Temperature effects are nullified by using titanium as a material of construction, and periodic drift checks may be made with an internal pneumatic ram actuated from an external air pressure source. (Official Gazette)

27180 IMPLICATIONS OF AUTORADIOGRAPHIC READ-OUT OF INFORMATION FROM PHOTOGRAPHS. Thackray, M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 571-574(Oct 1973).

Autoradiography of radioactive silver images permits retrieval of information from a much smaller number of silver grains than is required when the transmission of visible light is used to retrieve the information. In addition, films used for purposes such as radiography are no longer required to be transparent after processing when examined by this technique. Removal of these restrictions of image visibility and film transparency should open a large new field of research aimed at increasing photographic speed. (auth)

27181 TRACK-DELINEATING AUTORADIOGRAPHY IN METALLOGRAPHIC INSPECTION OF TARGETS OF THE TRANSURANIUM ELEMENTS. Polyukhov, V. G.; Syuzev, V. N.; Chushkin, Yu. V.; Antipina, M. M. At. Energ. (USSR); 33: No. 3, 773-774(Sep 1972). (In Russian).

This paper was summarized as paper No. 604/6658 with full copy held by TIC.

The method of track-delineating autoradiography on photosensitive glass was used to study the distribution of active grains with transuranium elements over the cross section of polished sections made from two dispersion type targets irradiated in the central channel of an SM-2 reactor. In the specimens investigated, 96 to 99% of all of the events of spontaneous fission of heavy nuclides were accounted for by ^{252}Cf, amounting to 7×10^4 to 4×10^5 fissions/min per mg of the starting plutonium–aluminum composition. Autoradiographs of two types were used: one with an aluminum filter (thickness ~3 mg/cm^2) between the photosensitive glass and the surface of the specimen, the other without a filter. In the first case, products of spontaneous fission ejected solely from the surface of the specimen become recorded in the autoradiographs, while in the second case products originate in layers located within the specimen. The exposure time was from 15 to 60 min. Objective data on the distribution pattern of grains containing ^{252}Cf were obtained through photometric scans of the autoradiographs taken on an MF-4 microphotometer. The integral and differential distribution curves of the grains were studied. The resulting autoradiographs made it possible to determine the rate of erosion of the envelope, and of the assumed migration of active material into the envelope. An MBI-3 microscope was used to study the microstructure of individual grains on the autoradiographs. Comparison of the results obtained and data from investigations using the method of analysis of microphotographs of the same polished sections disclosed that the use of track-delineating autoradiography on glass considerably broadens the options of metallographic investigations of targets irradiated in a reactor, with minimum effort and cost in producing the targets. (auth)

27182 NEUTRON RADIOGRAPHY FOR NUCLEAR PROBLEMS. Jain, N. C.; Dande, Y. D.; Udyavar, R. S. (Bhabha Atomic Research Centre, Trombay, India). pp 501-505 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27183 RADIOGRAPHY USING SCATTERED GAMMA-RAYS. Tsujii, Y.; Furuta, J.; Hiraoka, E. (Radiation Center of Osaka

Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 104-107(Mar 1973).

A radiograph of the lining material attached to a concrete wall was attempted using the backscattered radiation generated in the concrete. The image quality of radiograph taken by this method was no better than the usual ones, but the fundamental data obtained show the possibility of using this method for the inspection of metal linings. (auth)

Nuclear Explosions

Refer also to abstracts 27242, 27332, 27336, 27607, and 29379.

27184 (AD-756891) SEISMIC DATA LABORATORY QUARTERLY TECHNICAL SUMMARY REPORT, OCTOBER-DECEMBER 1972. Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA)). 15 Jan 1973. Contract F33657-72-C-0009. 14p. NTIS.

Work done during the period October through December 1972 is summarized, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects are discussed. (auth)

27185 (AD-756892) INVESTIGATION OF THE SIGNAL ENHANCEMENT AND DISCRIMINATION CAPABILITIES OF THE INTERMEDIATE PERIOD STRAIN-PENDULUM SEISMOGRAPH COMBINATION AT HNME (HOULTON, MAINE). Der, Z. A. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 27 Sep 1972. Contract F33657-72-C-0009. 90p. (SDL-294). NTIS.

The intermediate period strain-pendulum combination at HNME is very effective in reducing 4 to 8 s, microseisms and enhancing body phases. The spectra and the relative excitation of intermediate period P and S waves show good potential as discriminants between earthquakes and explosions. If, however, discrimination can be made using 1 and 20 sec information, then standard instruments have a lower threshold. The spectral behavior of body and surface waves is sensitive to the local structure, and knowledge of the local structure is needed for the refinement of signal processing methods for strain-pendulum combinations. If such knowledge is not available the best method is to design a processor on the basis of noise characteristics alone. Restricting the processor filter to be one-sided relative to zero lag time (physically realizable) degrades the filter performance relative to the two-sided filters but not significantly. (auth)

27186 (AD-756894) P AND PKP CODA DECAY CHARACTERISTICS FOR EARTHQUAKES. Cohen, T. J.; Sweetser, E. I.; Dutterer, T. J. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 20 Nov 1972. Contract F33657-72-C-0009. 197p. (SDL-301). NTIS.

P and PKP coda characteristics were determined for earthquakes from 15 seismic regions as recorded at 17 World Wide Standard Seismograph Stations (WWSSS). In determining the coda characteristics for an event, amplitude measurements, scaled relative to the largest excursion in the coda, are made in successive time windows, and the coda envelope obtained by connecting successive observations. The individual coda, average coda, and standard deviations about the average coda as a function of time into the coda (in units of m (b)) are given for each set of measurements. The coda for events individual coda, average coda, and standard deviations about the average coda as a function of time into the coda (in units of m (b)) are given for each set of measurements. The coda for events in a given region recorded at a given distance are found to be very similar to the coda for events from another region recorded at the same distance. That is, coda characteristics are determined primarily by the arrival times and amplitude of significant secondary phases. (auth)

27187 (AD-756896) SEISMIC ARRAY ANALYSIS CENTER QUARTERLY TECHNICAL SUMMARY REPORT, OCTOBER-DECEMBER 1972. Dean, W. (Teledyne Geotech, Alexandria, Va. (USA)). 19 Jan 1973. Contract F33657-72-C-0471. 13p. NTIS.

The operations and accomplishments in the SAAC for the period of October, November, and December 1972 are summarized. Included are SAAC operation, evaluation, documentation, and programming, and data requests. (NTIS)

27188 (AD-756897) SPATIAL COHERENCE OF SURFACE WAVES. Mack, H. (Teledyne Geotech, Alexandria, Va. (USA)). 20 Dec 1972. Contract F33657-72-C-0471. 41p. (SAAC-TR-8). NTIS.

Using spatial coherency estimates of Rayleigh and Love waves recorded at ALPA, LASA and NORSAR, it was demonstrated that for a particular frequency the wave propagation cannot be described by a unique wave vector. Instead, the propagation is better described by a distribution in the wave number domain or, in physical terms, a distribution in azimuth and phase velocity. In general the coherency in the mean direction of propagation, which is a function of the velocity distribution, stays high relative to the coherency along the mean wave front, which is a function of the azimuthal distribution. (auth)

27189 (AD-756904) ADAPTIVE CONVERGENCE STUDIES. Extended Array Evaluation Program. Booker, A. H.; Ong, C. Y.; Barnard, T. E. (Texas Instruments Inc., Dallas). 30 Apr 1972. Contract F33657-71-C-0843. 39p. (TI-SR-1). NTIS.

The study investigated the ability of a modified adaptive algorithm to increase the convergence rate on weak noise components. A detailed mathematical derivation of the modified algorithm is presented. In addition, performance of the algorithm on synthetic data is evaluated. The algorithm is applied in both a single loop and a two loop mode. Both single-constraint and multiple-constraint modes of operation are investigated. The results of the study indicate that the multiloop adaptive filtering algorithm can be used to speed the rate at which an adaptive filter set approaches optimality. (auth)

27190 (AD-756905) EXTENDED ARRAY EVALUATION PROGRAM. Final Report, 1 April 1971-31 March 1972. Harley, T. W. (Texas Instruments Inc., Dallas). 31 Mar 1972. Contract F33657-71-C-0843. 48p. NTIS.

The material covered in the Extended Array Evaluation Program is summarized and the conclusions obtained are discussed. The individual tasks covered include evaluations of the Alaskan Long Period Array, the long period Norwegian Seismic Array, the short period Norwegian Seismic Array, and the stations of the Very Long Period Experiment. In addition, studies of network capabilities and analysis techniques, of adaptive processing techniques, and of high-resolution frequency wave number spectral techniques are reported. (auth)

27191 (AD-759270) FKCOMB, A FAST GENERAL-PURPOSE ARRAY PROCESSOR. Smart, E. (Teledyne Geotech, Alexandria, Va. (USA)). 20 Dec 1972. Contract F33657-72-C-0471. 30p. (SAAC-TR-9). NTIS.

FKCOMB, a fast general-purpose array processing program which employs frequency-wave number analysis is described. A quasi-online long-period array processing package has been designed around FKCOMB for use at the Seismic Array Analysis Center. The input parameters required for operating the program are described. (auth)

27192 (AD-759273) SPECIAL DATA COLLECTION SYSTEMS. Final Report, 1 September 1970-30 September 1972. (Teledyne Geotech, Garland, Tex. (USA)). 15 Nov 1972. Contract F33657-71-C-0337. 124p. NTIS.

The work performed during the period 1 September 1970 through 30 September 1972 is described. Ten portable system teams were deployed to participate in the CANNIKIN experiment. The portable system instrumentation was modified to provide greater system sensitivity. The comparison study of the noise level recorded by long-period seismographs in two types of surface vaults indicates that the noise levels are virtually identical and no significant difference in noise level exists. A study of atmospherically-generated seismic noise as a function of depth was not able to be completed due to the existence of a component of pressure-related noise which generally exceeded the theoretical earth noise contribution. The basic characteristics of this pressure-related noise are described and an explanation for its origin offered. (auth)

27193 (AD-761812) LONG-TERM BROAD-BAND VERTICAL EARTH NOISE STRUCTURE AT VERY LONG PERIOD EXPERIMENT SITES. Alsup, S. A.; Becker, E. S. (Texas Instruments Inc., Dallas). 21 Feb 1973. Contract F33657-72-C-0725. 50p. (TI-SR-3). NTIS.

A series of one-hour samples of seismic noise have been taken from vertical instrument channel recordings at the Very Long Period Experiment (VLPE) sites for evaluation of the long-term broad-band earth noise field in the VLPE network. Converted power spectral density estimates of the root-mean-square noise amplitudes in the samples were corrected for channel response characteristics and then examined for long term trends and both broad and narrow band variability. Correlation of intraband noise variability is discussed. (auth)

27194 (AD-761813) EXTENDED ARRAY EVALUATION PROGRAM. Quarterly Report No. 3, 1 October-31 December 1972. Harley, T. W. (Texas Instruments Inc., Dallas). 15 Jan 1973. Contract F33657-72-C-0725. 12p. NTIS.

The Alaska Long Period Array; Norwegian Seismic Array long period; Norwegian Seismic Array short period; Very Long Period Experiment; and Network evaluation programs are summarized. (NTIS)

27195 (AD-761822) LONG-PERIOD RAYLEIGH WAVE SPECTRA FROM EARTHQUAKES AND EXPLOSIONS. Alexander, S. S.; Lambert, J. W. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 2 Mar 1973. Contract F33657-72-C-0009. 39p. (SDL-307). NTIS. / /

Comparisons are made of Rayleigh wave spectra for Nevada Test Site explosions and Nevada earthquakes and for a limited number of teleseismic explosions and earthquakes recorded in North America. For a given combination of source and receiver location, the explosions consistently exhibit the same spectral shape over a significant range of magnitudes while spectral shapes for earthquakes commonly vary in a manner that appears independent of magnitude, with some earthquake shapes closely matching those of explosions. The spectral shapes for explosions were commonly observed to vary significantly from station to station at comparable distance ranges, probably because of path and receiver site effects. Neither Rayleigh spectral shape nor symmetry of raw surface wave radiation patterns is likely to be a reliable discriminant in general. (auth)

27196 (SLA-73-607) SUMMARY OF WIND TUNNEL DETERMINED AERODYNAMIC COEFFICIENTS FOR THE 155 MM XM549 PROJECTILE CONFIGURATION. Wilson, G. G. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 41p. Dep. NTIS $5.45.

During Phase 2 studies for the development of a 155 mm Artillery-Fired Atomic Projectile (AFAP), it became apparent that in order to achieve a ballistic match between the AFAP and the standard HE projectile, the projectile's aerodynamic parameters must be well known. Wind tunnel tests were conducted to experimentally determine aerodynamic coefficients for the 155 mm XM549 projectile for a Mach number range of $0.5 \leq M \leq 2.46$. (auth)

27197 (SLA-73-5619) DISTANT BLAST PREDICTIONS FOR EXPLOSIONS. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex.). 1973. 22p. (CONF-730939-1). Dep. NTIS $3.25.

From 15th annual explosives safety seminar; San Francisco, California, USA (18 Sep 1973).

The prediction of blast effects and the probability of window damage from distant explosions is discussed. Data from both HE and nuclear explosions were used to evaluate the offsite propagation of blast waves. The effects of meteorological conditions, including seasonal variations in winds and temperatures, altitude, and the strength of the glass are considered. Empirical data on damage from blast waves are given. (LCL)

27198 (SLL-73-38) SEISMIC TRANSMISSION TESTS: VIBRATORY SOURCE. Starkey, D. B. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. Contract AT(29-1)789. 79p. Dep. NTIS $6.00.

As a part of the Sandia Laboratories' Plowshare program to study the feasibility of through-the-earth communication systems, a vibrator, capable of introducing sinusoidal signals into the earth, was tested at the Nevada Test Site in February 1972. The tests were conducted to determine at what depth and slant range signals could be detected. The tests showed adequate signal-to-noise ratios at depths of 4400 feet (the maximum hole depth) and slant ranges over 8100 feet. The system could be used to initiate underground nuclear devices, thereby, eliminating the necessity of cables. (auth)

27199 (SLL-73-5250) ON THE FEASIBILITY OF ELECTROMAGNETIC COMMUNICATION THROUGH THE EARTH FOR COMMAND AND CONTROL OF SEQUENTIALLY FIRED PLOWSHARE EXPLOSIVES FOR GAS WELL STIMULATION. Tockey, R. J. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. Contract AT(29-1)-789. 37p. Dep. NTIS $4.00.

A theoretical analysis is made of the feasibility of an electromagnetic communications system for use in command and control of sequentially fired plowshare explosives for gas well stimulation. Since proof of feasibility is expensive and difficult and ultimately requires demonstration of a working model, this report uses inverse reasoning and attempts to prove that such a system could not meet reliability and premature probability requirements within practical bounds for parameters such as size and power. Based on statistical communications theory, the system is modeled using best available information for system dynamics and parameters of concern. System noise is estimated, and a modified formulation of the "receiver operating characteristic" is developed for the optimal receiver for detection of a known signal in white Gaussian noise that seems to make it especially adapted to the present problem. Required signal energy and average transmitter power are estimated for a reasonable set of communication requirements. It is concluded that if a nearly optimal implementation could be realized within the constraints of the application, and if the requirements assumed in this analysis are reasonable, then the concept has not been proved infeasible. (auth)

27200 (UCID-16314) ANALYZING OF SURFACE-MOTION DATA FROM OLD RELIABLE MINE BLAST. Sisemore, C. J. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Jul 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $3.25.

Seismic data from the Old Reliable Mine blast were studied to evaluate the utility of applying current prediction schemes to predict seismic motions in the Galiuro mountains north of Tucson, Arizona. Air-blast, earth-motion, and structural-response measurements were made at various stations surrounding the blasting point. The major objectives were not realized, but plots were made for Fourier spectra and earth velocity versus range. (auth)

27201 FALLOUT FROM NUCLEAR EXPLOSIONS. I. Short-Term Effects. pp 316-353 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Nuclear and thermonuclear explosions are discussed in general and the principal radiological consequences of the use of such weapons in war are reviewed. Topics discussed are physical aspects of nuclear explosions (methods of dose calculation; short-term effect of fallout; and livestock and wildlife damage), and some problems of recovery from nuclear attack. (DHM)

27202 PEACEFUL USES OF NUCLEAR EXPLOSIVES. pp 392-399 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The radiation doses to man from the peaceful uses of nuclear explosives including nuclear excavation and nuclear stimulation of gas wells are discussed. The activation products and fission products produced by a 1 megaton device in basalt are given. (ERB)

Protective Structures and Equipment

Refer also to abstract 29555.

27203 (LA-5352-MS) HEPA FILTER EFFECTIVENESS DURING TORNADO CONDITIONS. Gregory, W. S. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

A preliminary investigation of the response of HEPA (high efficiency particulate air) filters to hypothetical tornado-generated pressure drops has been initiated. A small scale experimental apparatus suitable for testing 8-by-8-inch HEPA filters was constructed and operated for simulation of a pressure transient which achieves a 3-psi pressure magnitude during a three second rise time, maintains the 3-psi pressure for three seconds and then returns to ambient conditions in the next three seconds. It was determined that 24-by-24-inch HEPA filters should be tested for the pressure transient and that it is possible to simulate the hypothetical tornado condition using the small scale apparatus. An experimental design for testing the 24-by-24-inch filters was made. The data indicates that an air velocity of 90 fps will be generated through the test filter as a result of the 3-psi pressure drop. Visual inspection of the filters tested revealed no obvious structural failure and in addition no change was found in the efficiency of the filters after the tests. Flow-resistance data obtained indicates that the resistance of HEPA filters is independent of the depth of the filters at high flow rates. The velocity-resistance relationship shows a rate of increase in resistance at 60 fps. (auth)

27204 PANORAMIC DENTAL X-RAY INSTALLATION STRUCTURAL SHIELDING AND OPERATOR PROTECTION REQUIREMENTS. Zelac, R. E. (Temple Univ., Philadelphia). Health Phys.; 25: No. 5, 521-523 (Nov 1973).

The purpose of this note is to provide some practical information which can be employed in determining appropriate shielding for extraoral source panoramic dental units. Since a narrow beam is employed in a panoramic installation and because the cassette holder serves as a barrier for the primary beam, less structural shielding is required than for a conventional machine. An existing installation was considered and the shielding which would be required were the unit a conventional one, the shielding required based on calculation taking into account the small beam area of the panoramic unit, and the actual shielding required based on radiation measurements, were compared. It is concluded that by each of these approaches unnecessary expense

for shielding could be incurred. However, working on anticipated work-load and distances to occupied areas, leakage radiation and the exposure information given in this note it is considered that no shielding would be required beyond that afforded by existing walls and partitions. (UK)

Safety Engineering

Refer also to abstracts 29507, 29558, and 29570.

Vacuum Engineering

27205 BEHAVIOR OF PERFLUOROPOLYETHER AND OTHER VACUUM FLUIDS UNDER ION AND ELECTRON BOMBARDMENT. Holland, L.; Laurenson, L.; Hurley, R. E.; Williams, K. (Edwards High Vacuum International, Manor Royal, Eng.). Nucl. Instrum. Methods; 111: No. 3, 555-560(1973).

A study of perfluoropolyether fluids under electron and ion bombardment has shown them to be well suited for vacuum use in the presence of charged particles. A dc glow discharge was sustained in hydrogen, oxygen, helium, air, argon, and Freon 14 between plane electrodes previously smeared with perfluoropolyether. After the discharge both the cathode and the anode surfaces remained visually clean except when hydrogen was used as a discharge gas when a polymer-like film was formed on the cathode and a brown film deposited on the anode. The brown deposit on the anode was a neutral condensate formed independently of electron bombardment. For comparison Apiezon C, Silicone 704, Santovac 5 and Dow Corning FS.1265, were also exposed to argon and hydrogen dc glow discharges, when solid deposits were produced on both anode and cathode. Perfluoropolyether fluid was then smeared in the quartz bottle of an rf ion source and discharges were run in hydrogen and argon; considerable etching was observed on the inside of the bottle. By comparison a smear of Santovac 5 in the bottle did not give rise to etching but left a tarry deposit. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

27206 (BNWL-1751(Pt. 2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1972 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Volume II. Physical Sciences. Part 2. Radiological Sciences. Nielsen, J. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 125p. Dep. NTIS $3.00.

Separate abstracts were prepared for 63 of the individual sections of this report. (JFP)

For abstracts of individual sections see: 26955–26959, 26986, 27004–27012, 27062, 27217–27221, 27251–27255, 27274–27278, 27287–27290, 27325, 27380, 27465, 27466, 27536, 27537, 27592, 27594, 27595, 27600, 27605, 27658, 28215, 28216, 29082, and 29469–29481.

27207 PRIMER ON ENVIRONMENTAL IMPACT STATEMENTS. Barbaro, R.; Cross, F. L. Jr. Westport, CT; Technomic Publishing Co., Inc. (1973). 146p.

Guidelines and techniques for preparing Environmental Impact Statements are presented. Chapter titles include: overview; legislation; systematic approach to environmental impact statement; evaluation of air pollution impact; evaluation of water pollution impact; evaluation of the impact from disposal of solid wastes; evaluation of noise impact; environmental impact from marine facilities; various types of environmental impact statements; and future trends. (JGB)

27208 COLUMBIA RIVER STORY: AN EXAMPLE OF AEC RESEARCH. Osterberg, C. L. (Atomic Energy Commission, Washington, DC). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Research work over the past 28 years on the Columbia River, its estuary, and nearby Pacific Ocean by AEC contractors is reviewed. (ERB)

Minerals and Ores

Refer also to abstracts 27059 and 27641.

27209 (GJO-100(73)) STATISTICAL DATA OF THE URANIUM INDUSTRY. (Grand Junction Office (AEC), Colo.). 1 Jan 1973. 68p. Dep. NTIS $5.50.

Statistical data of the uranium industry as of January 1, 1973, are presented. Sections are included on: ore and concentrates purchases; uranium resources; distribution of deposits; drilling statistics; uranium exploration expenditures; land holdings for uranium mining and exploration; employment; commercial U_3O_8 sales and requirements; and processing mills. (DHM)

27210 (GJO-105) NUCLEAR FUEL RESOURCE EVALUATION: CONCEPTS, USES, AND LIMITATIONS. (Grand Junction Office (AEC), Colo.). May 1973. 27p. Free GJO.

The objectives, criteria, and methods involved in the resource evaluation program are described. The main objectives of the resource evaluation program are: a. To determine the magnitude of current domestic uranium ore reserves at various production costs. b. To estimate, using current knowledge, the additional undiscovered uranium resources which might occur in identified favorable areas and other areas. c. To analyze and forecast the capability of the uranium mining and milling industry to produce uranium concentrates from these resources in order to supply the national nuclear fuel demand. (DHM)

27211 (NP-19704-P1) GEOLOGICAL PROSPECTION FOR RADIOACTIVE MINERALS, 1969 SUMMER SCHOOL. Report of the Session: Part I. General Proceedings. (Sculoa Enrico Mattei E. N. I., Milan (Italy)). 1970. 246p.

Titles of the ten papers presented at the 1969 summer school are: political economy problems in geological prospection for radioactive minerals; Uranium: the present and the future; forecasts on the distribution of uranium deposits in the world; methods of prospecting for radioactive minerals; basic geological criteria for the search of uranium in the Precambrian shields and its sedimentary cover; airborne gamma ray spectrometer surveys; geochemical methods in prospecting for uranium; uranium ore discovery in Niger; the uranium occurrences in the Alps; and Novazza uranium deposit (Bergamasque Alps). (DHM)

27212 (NP-19704-P2) GEOLOGICAL PROSPECTION FOR RADIOACTIVE MINERALS, 1969 SUMMER SCHOOL. Report of the Session: Part II. The Geology of Uranium and Thorium. Van Wambeke, L. (Sculoa Enrico Mattei E.N.I., Milan (Italy)). 1970. 171p.

Course lectures on uranium and thorium geology given by Dr. L. Van Wambeke are presented. Chapter titles are: physical and chemical properties of uranium and thorium; mineralogy of uranium and thorium, geochemistry of uranium and thorium; main characteristics of the uranium and thorium deposits of the world; methods of prospecting for radioactive minerals; and uranium and thorium reserves and resources and the outlook for uranium. (DHM)

27213 YADERNAYA VULKANOLOGIYA. (Nuclear Volcanology). Cherdyntsev, V. V. Moscow; Izdatel'stvo Nauka (1973) 208p.

This book is the first in the world literature with a summary of nuclear volcanology–a study of the behavior of radioactive isotopes and their decay products in volcanic processes during removal of material from the interior of the earth. In the resolution of this task, radioactive isotopes have a remarkable value, in that in the interior they exist in a strict given state of radioactive equilibrium. A study of isotope composition gives with complete certainty laws of their distribution during their transfer to the surface of the earth. A great deal of experimental material, collected in recent years from mostly Soviet studies, make it possible to establish a series of similar regularities, having value not only for volcanology, but for studies of the properties of the upper mantle and formation of the earth's crust through volcanic deposition of continents and oceans. (tr-auth)

27214 CERTAIN PECULIARITIES IN THE BEHAVIOR OF URANIUM DURING FORMATION OF URANIUM–MOLYBDENUM DEPOSITS. Mel'nikov, I. V.; Berzina, I. G. At. Energ. (USSR); 35: No. 1, 3-9(Jul 1973).

It is shown that in the indicated deposits uranium in solution has undergone migration twice. The first time in the stage of pre-ore, quartz–carbonate–hydromicaceous changes in strata together with thorium, rare earths and zirconium, and the second time in the stage of molybdenite–uraninite together with molybdenum, lead, antimony, zirconium, and beryllium. In the quartz–carbonate–sulfide stage of mineral formation, which divides the above two stages, a transfer of uranium in solution in noticeable quantities did not occur. In the uraninite stage there occurred a redistribution of previously deposited uranium without its introduction. One possible explanation for the interruption in the transfer of uranium in a single hydrothermal process is the sharp increase in the ratio of H_2/CO_2 in solution observed in other types of deposits. (auth)

27215 AUSTRALIA PREPARES FOR RENEWAL OF URANIUM PRODUCTION. Energy Dig.; 1: No. 1, 23-24(Aug 1972).

A summary is presented of uranium mining in Australia. Ore deposits in Northern Territory, Western Australia, South Australia and Queensland are mentioned, together with available information about estimated reserves and further exploration. Trading activities and contracts are discussed. (UK)

27216 K, U, AND Th DISTRIBUTION BETWEEN DRY AND WET FACIES OF A SYENITIC INTRUSION AND THE ROLE OF FLUID CONTENT. Smithson, S. B.; Decker, E. R. (Univ. of Wyoming, Laramie). Earth Planet. Sci. Lett.; 19: No. 2, 131-134(Jun 1973).

Syenitic intrusions of the Laramie anorthosite complex consist of a biotite-hornblende syenite and a pyroxene syenite. Rocks of the two related types of syenite show practically the same major element chemistry, but concentrations of U and Th are much higher in the "wet" biotite-hornblende syenite than in the "dry" pyroxene syenite. A strong empirical relationship between hydrous mineralogy and higher U and Th concentrations is established. If U and Th are strongly concentrated upward in granitic intrusions this cannot be caused by differentiation affecting major elements; such an upward concentration of U and Th could be caused by upward differentiation of H_2O. (auth)

Radioactive Effluents

Refer also to abstracts 27203, 27237, 27291, 27313, 27339, 29176, 29182, 29221, 29432, and 29435.

27217 (BNWL-1751(Pt. 2), pp 1-2) ELEMENTAL CHARACTERIZATION OF SIMULATED URANIUM MINE ATMOSPHERES. Cooper, J. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The correlation of the high incidence of lung cancer and other respiratory ailments in uranium miners with lung exposure requires accurate characterization of the radionuclide, elemental, and organic content of the uranium mine atmosphere. Simulated uranium mine aerosols used in animal exposure chambers were characterized and compared to the aerosols found in operating uranium mines. (auth)

27218 (BNWL-1751(Pt. 2), pp 3-5) LOW-PRESSURE CASCADE IMPACTOR AND COUNTING SYSTEM FOR ANALYZING SUB-MICRON URANIUM MINE AEROSOLS. Jackson, P. O. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The investigation of uranium mine atmospheric contaminants requires a technique capable of relating each specific contaminant with its deposition pattern in the miner's respiratory tract. The cascade impactor is useful for characterizing the aerodynamic behavior of uranium mine aerosols because it can sample a sufficiently large volume and can permit subsequent analysis of the species present. A low-pressure cascade impactor was adapted for field use. This impactor, because it operates at low internal pressure, is capable of collecting unit density spheres with diameters as low as 0.06 μ. A suitable carrying wagon was constructed to hold the impactor and its vacuum pumps. Scanning electron microscopy was employed to obtain a three-dimensional view of deposits to permit particle size counting. (CH)

27219 (BNWL-1751(Pt. 2), pp 6-7) PARTICLE SIZE CHARACTERIZATION OF RADON DAUGHTERS IN URANIUM MINE AEROSOLS. Jackson, P. O. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

A low-pressure Andersen type cascade impactor having a last stage cutoff diameter of 0.06 μ for unit density spheres was evaluated and applied to the analysis of radon daughters in simulated uranium mine aerosols. One simulation employed normal laboratory air and 1200 working levels of radon daughters; the second simulation chamber also contained uranium ore dust, while the third contained these components plus diesel exhaust. The condensation nuclei count in the chamber with the radon daughters and the laboratory air was 20,000/cm^3 with about 30% of the RaA nuclei remaining unattached. The chamber with uranium ore added had a condensation nuclei concentration of 100,000/cm^3 and 1% unattached RaA. The chamber with the ore dust plus the diesel exhaust had 150,000 condensation nuclei per cm^3 and an unattached fraction of about 0.1%. (auth)

27220 (BNWL-1751(Pt. 2), pp 8-9) COLLECTION AND CHARACTERIZATION OF THE ORGANIC CONSTITUENTS OF AEROSOLS FOUND IN URANIUM MINES. Petersen, M. R. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Preliminary results are reported from the characterization of organic compounds present in uranium mine aerosols. The initial collection experiments were carried out in animal exposure chambers where diesel exhaust and uranium ore dusts were introduced in suitable concentrations to simulate conditions found in uranium mines. The particulate samples were collected with an Andersen cascade impactor (flow rate = 1 cfm; sampling time = 1 hr) which was carefully cleaned to remove interfering organic material. Unburned diesel fuel appeared in greatest concentration on the first stage and decreased down the stages until it was absent on the backup filter. Thus a rather coarse mist of raw diesel fuel occurred in the exhaust. A gross mixture of high molecular weight hydrocarbons was separated from the diesel fuel components in the chromatograms which correlated well with the visible soot load. The same samples were analyzed using an electron capture detector which is especially sensitive to polynuclear aromatic compounds. These initial studies showed that sufficient material can be collected in a reasonable sampling period for gas chromatographic studies of different sized particles for identification of organic chemical constituents. (CH)

27221 (BNWL-1751(Pt. 2), pp 61-84) TRANSPORT AND DEPLETION OF RADIONUCLIDES IN THE COLUMBIA RIVER. Robertson, D. E.; Silker, W. B.; Petersen, M. R.; Langford, J. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

With the closure of the last of the original Hanford plutonium production reactors in January 1971, there has been a decrease in radionuclide concentrations in the Columbia River and its biota. Three main mechanisms account for the reduced radioactivity levels in the river water and sediments: radioactive decay, scouring of surface sediments during high river flow and the subsequent flushing of the resuspended sediments into the Pacific Ocean; and burial of radioactive sediment deposits by fresh, relatively uncontaminated sedimentary material accumulated during low river flow. The river sediments remain the major repository for the Hanford origin radionuclides. River sediments are being studied to determine the conditions under which radionuclides are released from sediments to river water, to seawater, or for assimilation by river organisms. Radioactivity levels in the river water have decreased approximately tenfold between the summers of 1971 and 1972. The most abundant radionuclides presently in the water and sediments are ^{55}Fe, ^{60}Co, $^{152-155}$Eu, ^{65}Zn, and ^{137}Cs. Minor releases of fresh radioactivity to the river from the dual-purpose, power-Pu production, N reactor are being studied and their contribution to existing radioactivity levels in the river is being evaluated. (auth)

27222 CONTAMINATION OF THE ENVIRONMENT BY CARBON-14 PRODUCED IN HIGH TEMPERATURE REACTORS. Bonska, H. (Techniche Hochschule, Aachen); Schwarz, G.; Wibbe, H. B.; Boehnert, R. Kerntechnik; 15: No. 7, 297-300(1973). (In German and English).

The liberation of ^{14}C from high-temperature reactors is negligibly small, but the pollution by ^{14}C near large reprocessing plants in which heavy metal and graphite are separated by graphite combustion, cannot be neglected. The complete emission of the flue gas to the environment would not cause problems due to locally occuring high ^{14}C concentrations only up to thermal reactor outputs of the order of 5,000 MW. (GE)

27223 MAN-MADE TRITIUM. Crowson, D. L. (Atomic Energy Commission, Washington, DC). pp 23-27 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The major sources and mechanisms for the production of man-made tritium are reviewed. The topics considered are mechanisms for the production of man-made tritium, the extent of this production as compared to natural means of production, predictions of the rate of tritium generation by human activities in years to come, some problems concerning the management of man-made tritium, and some conclusions as to measures for reduction of tritium in the environment. (DHM)

27224 RADIOLOGICAL HAZARD FROM THE CONVERSION OF TRITIUM TO TRITIATED WATER IN AIR BY METAL CATALYSTS. Eakins, J. D.; Hutchinson, W. P. (Atomic Energy Research Establishment, Harwell, Eng.). Contract AT(40-1)-3944. pp 392-399 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

It was found that in a room completely lined with platinum, one of the best catalysts for the conversion of elemental tritium to tritiated water, it would take about 4 years for half the elemental tritium at an initial concentration of 10 (MPC)$_a$ to be converted to tritiated water. Thus, it is important to determine the chemical state of tritium in air before imposing unnecessary restrictions on the people at risk. (DHM)

27225 TRITIUM RELEASES FROM NUCLEAR POWER STATIONS. Krieger, H. L.; Gold, S.; Kahn, B. (National Environmental Research Center, Cincinnati). pp 557-564 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The release of tritium to the environment at routinely operating nuclear power stations and at a fuel reprocessing plant is reviewed on the basis of production estimates, operating reports by these facilities, and data from radiological surveillance studies. The latter were performed at a boiling water reactor (BWR), a pressurized water reactor (PWR), and a fuel reprocessing plant. (DHM)

27226 ENVIRONMENTAL TRITIUM CONTAMINATION FROM NUCLEAR POWER PROGRAM. Gupta, V. K.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). pp 564-571 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

An attempt was made to estimate the sources of tritium available for release to the environment as a result of the nuclear power program during this decade (1970–1980). Environmental consequences at two sites, RAPP and Kalpakkam, are shown to be insignificant from radiological safety considerations under normal conditions. (auth)

27227 HEALTH PHYSICS ASPECTS OF A LARGE ACCIDENTAL TRITIUM RELEASE. Myers, D. S.; Tinney, J. F.; Gudiksen, P. H. (Univ. of California, Livermore). pp 611-622 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Results from an environmental and bioassay sampling program indicate that no significant exposure to on- or off-site individuals resulted from the release. All samples of water, milk, and urine contained normal background levels of tritium. Although detectable levels of activity were found in some vegetation and atmospheric water vapor samples, the highest measured concentrations as well as the calculated minimum credible ground-level air concentrations during cloud passage were well below the off-site maximum permissible concentrations for continuous exposure. If all of the tritium was assumed to be converted to the oxide form, the calculated maximum exposure at the site boundary as a result of exposure to the cloud would be 300 mrem. Since tritium was not present in urine samples above detectable levels, the maximum undetectable dose which could have been received would have been about 0.025 mrem. Based on vegetation-sampling results, the maximum credible dose to a child exposed via the forage-cow-milk pathway would be about 70 mrem. (auth)

27228 AQUATIC RADIOLOGICAL ASSESSMENTS AT NUCLEAR POWER PLANTS. Lentsch, J. W. (Portland General Electric Co., OR). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The dose to man resulting from radionuclides released in nuclear plant liquid effluents will be determined by the specific nuclides and environmental pathways that exist at each particular plant. Simple approximate methods can be employed to calculate the dose from many such nuclides and pathways. While the accuracy of calculated doses is difficult to illustrate, it can usually be shown sometimes by intuition, that they are conservative. The effort that should be expended in estimating doses from predicted or measured releases should be determined by preliminary calculations similar to those given here. The magnitude of the preliminary dose estimates will then define the need for more accurate estimation methods and will, furthermore, identify those nuclides and pathways that should be considered in more detail. The environmental radiation monitoring program should be dose oriented with respect to sample types, locations, collection and analysis frequencies, and types of analyses. Upper limits to the dose from each nuclide that is predicted or measured in effluent can be determined from detection limits for the analysis of samples from each environmental pathway. (auth)

27229 NATURAL AND ARTIFICIAL ORIGINS OF TRITIUM; ITS IMPACT ON THE ENVIRONMENT. Douellous, D. Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 71-80(Apr 1973). (In French).

Tritium is formed naturally by the action of cosmic radiation on oxygen and nitrogen atoms in the air, and at the earth's surface by the transmutation of lithium. Artificially induced nuclear phenomena lead to the production of quantities of tritium that are large in comparison with those produced naturally. Such sources result from military applications and thermonuclear reactions involved in industrial applications, nuclear power plants, and processing plants. The increase in the ambient tritium level does not present any immediate danger for plants, wild animals, air, or water. (FR)

Radioactivity Monitoring and Transport

Refer also to abstracts 27148, 27201, 27411, and 27414.

27230 (CONF-710501-P1, pp 3-8) CONTRIBUTIONS OF RADIOECOLOGY TO AEC MISSION PROGRAMS. Auerbach, S. I. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The contributions made by radioecological studies to the AEC are discussed. These contributions center around the general areas of the fate of radionuclides in ecosystems and the effects of chronic low-level irradiation on biological materials. The contributions are viewed in terms of their value to society. The role of radioecology and related disciplines is to ensure that the technical objective of safety is attained and that environmental impact is minimal. (ERB)

27231 (COO-1731-4) FREE LIVING MITES OF THE NEVADA TEST SITE. Final Report. Jorgensen, C. D. (Brigham Young Univ., Provo, Utah). 1970. Contract AT(11-1)-1731. 47p. Dep. NTIS $4.50.

The effects of nuclear weapons testing on the species composition and distribution of mites in the Nevada Test Site area were studied. Sampling sites are described and a map is presented to show the location. A table is presented to show average beta and gamma radiation levels at various locations within the sampling sites. Methods of collecting mites from vegetation are described and mathematical formulas for determining ratios of predaceous, phytophagous, and scavenger mites are presented. Seventeen phenotypically distinct groups of mites were identified and a table is presented to show numbers of mites in each group for all samples taken. Graphs are presented to show species diversity indices at various sites; the effect of radiation stress, primarily beta, was to increase the species diversity. The effects of radiation stress on trophic level organization are indicated by means of graphs that show ratios of predaceous mites to phytophagous and scavenger forms. A list is presented of 111 plant species from which mites were collected and a list of approximately 400 species of mites collected is presented. (HLW)

27232 (RL-73-35) RADIATION PROTECTION GROUP (OPERATIONS) PROGRESS REPORT FOR 1972. Hack, R. C. (Rutherford High Energy Lab., Chilton (England)). Apr 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The report of the Rutherford High Energy Laboratory Nimrod Division Radiation Protection Group includes the following items: environmental monitoring (Nimrod area (residual activity, machine prompt leakage radiation)); personal monitoring; radioactive sources, waste disposal and hazards from high voltage equipment; discussion of future situation due to up-rating of Nimrod's injection system from 15 MeV to 70 MeV. (UK)

27233 (SCPRI(RM)-3-1973(Suppl.)) ANNEX TO MONTHLY REPORT, MARCH 1973. Detail of Results of Measurement. (Service Central de Protection Contre Les Rayonnements Ionisants, le Vesinet (France)). 1973. 24p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-3-1973 report) are presented. (FR)

27234 (TID-26442) ENVIRONMENTAL MONITORING. Annual Report, 1972. Moore, J. D. (Atomics International, Canoga Park, Calif.). 1972. 27p. Dep. NTIS $3.50.

Environmental monitoring at Atomics International is performed by the Operational Safety and Waste Management Unit of the Health, Safety, and Radiation Services Department. Soil, vegetation, water, and air are routinely sampled up to a distance of 10 miles from Atomics International sites. Site perimeters are monitored for radiation levels by means of thermoluminescent dosimeters. The environmental radioactivity reported herein is attributed to natural causes and to nuclear weapons testing, rather than to Atomics International operations. (auth)

27235 (UCRL-51444) ATMOSPHERIC SCIENCES GROUP, PHYSICS DEPARTMENT, LAWRENCE LIVERMORE LABORATORY PROGRAM REPORT: FY 1973. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Aug 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

The research program in the atmospheric sciences at the Lawrence Livermore Laboratory is reviewed. The program is responsive to a number of national needs (outlined for both civil and military categories). Capabilities for regional modeling of air pollution by chemical or contamination by radioactive materials and the development of numerical models of particle transport and deposition are stressed. (CH)

27236 (WASH-1259) ENVIRONMENTAL MONITORING AT MAJOR U. S. ATOMIC ENERGY COMMISSION CONTRACTOR SITES. Calendar Year 1972. (Division of Operational Safety

(AEC), Washington, D. C.). Aug 1973. 1195p. Dep. NTIS $16.25.

A compilation is presented of the annual reports for 1972 summarizing the results of the environmental monitoring programs conducted at each of the USAEC sites that have a potential for environmental impact or that release a significant quantity of radioactivity or nonradioactive wastes. Each contains data on the levels of radioactivity and nonradioactive pollutants in the environs of each site, and an interpretation of the sampling results in relation to the appropriate standards for environmental protection. The sites covered include: Bendix, Kansas City, Missouri; Los Alamos Scientific Laboratory, Los Alamos, New Mexico; Mound Laboratory, Miamisburg, Ohio; Mason and Hanger, Amarillo, Texas; Pinellas Plant, St. Petersburg, Florida; Rocky Flats Plant, Golden, Colorado; Sandia Laboratories, Albuquerque, New Mexico; Ames Laboratory, Ames, Iowa; Argonne National Laboratory, Argonne, Illinois; Battelle Laboratories, Columbus, Ohio; Brookhaven National Laboratory, Upton, New York; Elk River Reactor, Elk River, Minnesota; Dairyland Power Cooperative, Genoa, Wisconsin; National Accelerator Laboratory, Batavia, Illinois; National Reactor Testing Station, Idaho Falls, Idaho; Bettis Atomic Power Laboratory, Pittsburgh, Pennsylvania; Knolls Atomic Power Laboratory (Knolls Site, Kesselring Site, and Windsor Site); Shippingport Atomic Power Station, Shippingport, Pennsylvania; Nevada Test Site, Mercury, Nevada; Feed Materials Production Center, Fernald, Ohio; Oak Ridge Facilities (ORGDP, ORNL, and Y-12 Plant), Oak Ridge, Tennessee; Paducah Gaseous Diffusion Plant, Paducah, Kentucky; Portsmouth Gaseous Diffusion Plant, Piketon, Ohio; Hanford Site, Richland, Washington; Atomics International, Canoga Park, California; Lawrence Berkeley Laboratory, Berkeley, California; Lawrence Livermore Laboratory, Livermore, California; Stanford Linear Accelerator Center, Stanford, California; and Savannah River Plant, Aiken, South Carolina. (CH)

27237 TRITIUM. Conference Held at Las Vegas, Nevada, August 28–September 3, 1971. Moghissi, A. A.; Carter, M. W. (eds.). Las Vegas, NV; Messenger Graphics, Publishers (1973). 815p. (CONF-710809-).

Papers are presented on all aspects of tritium including history, production, measurement, biological effects and kinetics, environmental aspects, application, and health physics. Separate abstracts were prepared for seventy-two of the eighty-four papers presented in the book. The remaining papers and some papers presented at the conference but not included in the book appeared previously in NSA and can be located by referring to tae Report Number Index under Conf-710809. (DHM)

For abstracts of individual papers see: 27017–27021, 27045, 27068, 27125–27129, 27132–27135, 27223–27227, 27238–27244, 27262, 27263, 27272, 27283, 27317–27320, 27330, 27410–27416, 27596, 27627, 27645, 27646, 27651–27657, 27665, 27666, 27682–27685, 27696, 27697, 27994–27996, 29175, 29176, 29181, 29182, 29220, and 29221.

27238 ENVIRONMENTAL PROTECTION AGENCY'S ROLE IN ENVIRONMENTAL TRITIUM. Greenfield, S. M. (Environmental Protection Agency, Washington, DC). pp 12-14 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

27239 TRITIUM IN THE ATMOSPHERE AND OCEAN. Oestlund, H. G. (Univ. of Miami, Coral Gables, FL). pp 382-391 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritium content in the atmosphere and ocean is discussed with respect to global circulation of water, pathways of HTO in nature, tritiated water in rains, tritiated water in the oceans, tritium as an elemental hydrogen, and tritium in hydrocarbons. (DHM)

27240 ENVIRONMENTAL TRITIUM. Moghissi, A. A.; Carter, M. W. (National Environmental Research Center, Las Vegas, NV). pp 399-405 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The activities of the Environmental Protection Agency related to environmental tritium are described including air, water, and food monitoring programs associated with peaceful applications of nuclear energy and luminous compound preparation as well as fuel reprocessing and nuclear power production facilities. (DHM)

27241 GUIDANCE FOR LIMITING ENVIRONMENTAL RELEASES OF TRITIUM. Rohwer, P. S.; Kelly, M. J.; Booth, R. S. (Oak Ridge National Lab., TN). pp 422-430 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A description is presented of the Cumulative Exposure Index (CUEX) concept that is being developed to facilitate realistic assessment of the effect of environmental release of radionuclides. To assess the radiological dose for tritium within the CUEX concept, the possible consequence of an excavation exposure at the Nevada Test Site in late April was considered. (DHM)

27242 ENVIRONMENTAL TRITIUM SURVEILLANCE FOR PROJECT RULISON. Wruble, D. T.; Andrews, V. E.; Boysen, G. A. (National Environmental Research Center, Las Vegas, NV). pp 592-602 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Procedures and results of the off-site tritium monitoring program conducted during the reentry and production testing phase of Project Rulison are described. Since the surveillance showed that atmospheric moisture was the only source of tritium exposure to man, the monitoring data from these samples were used to estimate a possible dose from the flaring operations. Estimates showed that the maximum dose to a resident in the Project Rulison area from exposure to tritium was less than 0.001 mrem. (DHM)

27243 EXPERIMENTAL RESULTS FROM PROCESSING GAS-BUGGY GAS IN A NATURAL GAS PROCESSING PLANT. Kelly, M. J. (Oak Ridge National Lab., TN); Barton, C. J.; Meyer, A. S.; Chew, E. W.; Bowman, C. R. pp 603-611 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

An experiment is described that was performed to test the validity of prior calculations on the distribution of tritium among the various processing plant products ("dry" gas, butane, propane, and natural gasoline), to determine if isotopic exchange occurs between tritiated components of natural gas and the absorption oil used for product extraction, and to study the exposure of plant operating personnel during the processing of gas from a nuclearly stimulated well. (DHM)

27244 RADIOBIOASSAY AT THE KARLSRUHE NUCLEAR RESEARCH CENTER DURING THE YEARS 1967–1970. Schieferdecker, H. (Karlsruhe Nuclear Research Center, Ger.). pp 737-748 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

During 1967 and 1970 personnel of two heavy water moderated reactors, FR2 and MZFR, were surveyed for tritium content in urine samples. Methods used for calculation of body equivalent doses from the results of radiometric analysis of urine are described. Results indicate that radiation protection measures were adequate. (CH)

27245 ENVIRONMENTAL RADIOACTIVITY. Second Edition. Eisenbud, M. Environmental Sciences, an Interdisciplinary Monograph Series. New York; Academic Press, Inc. (1973). 554p. $29.50.

This second edition shows how radioactive substances introduced in air, water, and soil become involved in ecological processes that eventually affect man and all other biological forms. A separate abstract was prepared for each chapter. (DHM)

For abstracts of individual chapters see: 27058, 27148, 27201, 27202, 27246–27250, 27264, 27265, 27322, 27323, 27613, 27934, 27939, 29106, and 29246.

27246 INTRODUCTION. pp 1-13 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Topics considered include: the early history of radioactivity; the atomic energy industry; some introductory comments on the study of environmental radioactivity; comparison between radioactivity and chemical environmental contamination; and attitudes toward radioactive contamination of the environment. (DHM)

27247 FALLOUT FROM NUCLEAR EXPLOSIONS. II. Worldwide Effects. pp 354-391 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Topics considered include: amounts and distribution of radioactive debris produced in weapons tests; methods of estimating how the radioactive debris is partitioned among the three components of fallout (the fallout in the immediate vicinity of the explosion, the debris injected into the troposphere, and the debris injected into the stratosphere); and behavior of individual radionuclides produced in weapons tests (^{90}Sr, ^{89}Sr, ^{137}Cs, ^{14}C, ^{239}Pu, ^{238}Pu, radioiodine, lung dose due to inhalation of dust, external radiation, and miscellaneous nuclides). (DHM)

27248 ENVIRONMENTAL CONTAMINATION FROM ACCIDENTS. pp 400-431 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Information that has been obtained by studying the effects of certain accidents that have occurred up to the present is reviewed. The events discussed include: fallout from the thermonuclear detonation of March 1, 1954; the accident to the Windscale Reactor Number One of October, 1957; the Oak Ridge plutonium release of November, 1959; the Army Stationary Low-Power Reactor (SL-1); the Houston incident of March, 1957; Fermi Reactor fuel meltdown; abortive reentry of the SNAP 9-A; and the plutonium fire at Rocky Flats. (DHM)

27249 METHODS OF ENVIRONMENTAL SURVEILLANCE. pp 432-456 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The requirements for environmental surveillance programs in the vicinity of nuclear facilities are emphasized but the basic principles can be applied to the design of regional, national, or supernational monitoring networks. The subject is discussed under several headings as follows: 1. The preoperational phase, in which the environment is studied to identify the critical pathways in relation to: (a) the physical and chemical identity of the radioactive material that will be discharged to the environment; (b) the living habits of the potentially exposed population; and (c) the ecological mechanisms for dilution and concentration. 2. The postoperational stage, the design of which is based on information obtained in the preoperational study, modified as necessary by the performance of the facility and continuing observation of critical pathway kinetics. 3. A surveillance plan to be used in emergencies. (auth)

27250 ENVIRONMENTAL RADIOACTIVITY IN RETROSPECT AND PROSPECT. pp 457-478 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The radiation dose now received by mankind from both natural and artificial sources is summarized and some predictions as to the manner in which human exposure may be increased by the future growth of the nuclear industry are explored. (auth)

Atmosphere

Refer also to abstracts 27644, 28040, 29173, and 29478–29480.

27251 (BNWL-1751(Pt. 2), pp 29-31) USE OF NATURAL AND MAN-MADE RADIONUCLIDES TO STUDY IN-CLOUD SCAVENGING PROCESSES. Young, J. A.; Thomas, C. W.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The concentrations of cosmic-ray-produced radionuclides, nuclear-weapons-produced radionuclides, and radon daughters were measured simultaneously in rain and in ground level air samples at Quillayute, Washington in March 1972 and in northeastern Colorado in June 1972. The elapsed times between the beginning of droplet and/or ice crystal coalescence and the arrival of the precipitation at ground level, calculated on the basis of the $^{39}Cl/^{38}Cl$ ratios in the precipitation, averaged 50 minutes at Quillayute. In northeastern Colorado the calculated times averaged 70 minutes, except for a few samples near the middle of several storms which yielded calculated times of 6 to 29 minutes. The $^{39}Cl/^{24}Na$ ratios in the precipitation indicated that droplets growing by condensation experienced an increased rate of capture of newly formed cosmogenic radionuclides because of their increasing size and in northeastern Colorado because of their vertical displacement in the thunderstorm updrafts. (auth)

27252 (BNWL-1751(Pt. 2), pp 37-39) BEHAVIOR AND CHARACTERISTICS OF RADIOACTIVE DEBRIS FROM CHINESE NUCLEAR WEAPONS TEST OF MARCH 18, 1972. Thomas, C. W.; Silker, W. B.; Jenkins, C. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Radioactive debris from the Chinese nuclear test on March 18, 1972 was measured in milk samples collected in Washington and in air and in grass samples collected on two arcs from San Francisco to Seattle and from Texas to Chicago to determine the path of the debris, and the rate of deposition on the earth's surface. The concentrations in milk and grass were used to calculate the ^{131}I dose to man. (CH)

27253 (BNWL-1751(Pt. 2), pp 40-42) FALLOUT PLUTONIUM RADIONUCLIDE CONCENTRATIONS IN SURFACE AIR AT RICHLAND, WASHINGTON: EFFECTS OF SNAP-9A BURNUP. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The atmospheric concentrations of ^{238}Pu and ^{239}Pu were measured in surface air samples collected at Richland, Washington from 1963 to 1972. The amount of SNAP-9A burnup ^{238}Pu present was calculated from the ^{238}Pu concentrations and the $^{238}Pu/^{239}Pu$ ratios, assuming that the ratio in debris from nuclear weapons tests was 0.015. Calculations had indicated that the ^{238}Pu in Richland air from 1967 to 1971 came primarily from SNAP-9A. From 1967 to 1969 the concentrations of SNAP-9A plutonium at Richland had remained fairly constant, indicating that the ^{238}Pu was being transferred across the equator into the northern hemisphere at a rate comparable to the rate at which ^{238}Pu was being deposited on the earth's surface. The ^{238}Pu concentrations showed seasonal variations typical of radionuclides of stratospheric origin, so the transfer was probably taking place primarily in the stratosphere. Concentrations of SNAP-9A plutonium at Richland have decreased rapidly since that time. These results indicate that the stratospheric debris injected into the high stratosphere of one hemisphere will produce high concentrations of the debris in ground level air in the other hemisphere in the spring 1 to 2 years later. These concentrations will then remain constant for about three years before beginning to decrease. (CH)

27254 (BNWL-1751(Pt. 2), pp 42-45) FALLOUT ATMOSPHERIC RADIONUCLIDE CONCENTRATIONS AT RICHLAND, WASHINGTON AND AT POINT BARROW, ALASKA. Thomas, C. W.; Young, J. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The radionuclide concentrations in surface air samples collected at Richland, Washington (45° N) and at Point Barrow, Alaska (71° N) were compared. Essentially all of the radionuclides measured in the troposphere from 1962 to 1966 were formed in the 1961-62 test series. Since 1966, the contribution from Chinese and French nuclear tests has increased; at the present time essentially all of the nuclear weapons debris in the atmosphere is from the Chinese and French tests. The atmospheric concentrations of fallout radionuclides with half-lives greater than 1 year decreased 2 to 10-fold during 1972 at Richland and at Point Barrow, reflecting the lack of high-yield-weapons testing in the northern hemisphere during 1971. The atmospheric concentrations of the cosmogenic radionuclides ^{7}Be($t_{\frac{1}{2}}$ = 53 d) and ^{22}Na($t_{\frac{1}{2}}$ = 2.6 yr) have been measured continuously at Richland and at Point Barrow since 1964. Sodium-22 has been produced in significant quantities by nuclear weapons tests, but ^{7}Be has not, so the ^{7}Be concentrations have remained fairly constant from year to year. (CH)

27255 (BNWL-1751(Pt. 2), pp 46) PRELIMINARY FINDING OF THE CONCENTRATION OF ^{99}Tc IN ENVIRONMENTAL SAMPLES. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Considerable interest has recently been given to the distribution and source of ^{99}Tc in environmental samples, mainly because the reactions of Tc are similar to those of iodine in the human body and like iodine, Tc is concentrated in the thyroid. Preliminary results on the concentration of ^{99}Tc in surface air taken October 1970 at Richland, Washington indicated a value less than 0.012 dpm/10^3 scm. The fission yields for ^{99}Tc are slightly greater than 6% from both ^{239}Pu and ^{235}U fission, however the specific activity of ^{99}Tc is extremely low due to its half-life of ~210,000 years. If we assume ^{99}Tc and ^{137}Cs are present in air at ratios similar to their fission yields, we would estimate the ^{99}Tc concentration in surface air to be 0.0017 dpm/10^3 scm. This preliminary measurement would indicate that the ^{99}Tc concentration in surface air could possibly be as much as 7 times higher than would be predicted from fission. Such a value would seem entirely reasonable since substantial fractionation between the 99 and the 137 fission yield chains may occur shortly after detonation. Additional samples are presently being analyzed to determine actual rather than upper limit values for ^{99}Tc. (auth)

27256 (CONF-710501-P1, pp 177-182) DESERT VEGETATION UPTAKE OF TRITIUM FROM PROJECT GASBUGGY EFFLUENT. Mason, B. J.; Brown, K. W.; Hop, H. W.; Miller, C. L. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Tritiated water vapor released to the atmosphere by flaring of the natural gas taken from the Project Gasbuggy cavity provided a unique tracer for evaluating atmospheric distribution of the activity and its subsequent uptake by native desert plants. By using an appropriate vegetation sampling array, it was possible to identify points of maximum tritium uptake and to relate these to the effects of major terrain features on the wind flow patterns. The maximum concentration of tritium observed was in plants collected in the drainage wind pattern at a location ten miles from the release points. Data in the paper present the results in two forms. Specific activity (pCi/ml) of the water extracted from plant tissue indicates that there are a few locations where the tritium levels exceed the expected background. Variation in the data expressed in this way makes interpretation difficult. However, when the results are expressed on a dry weight basis, a definite pattern of activity appears in the samples collected in the valley through which the nighttime drainage winds flow. The peak in the activity occurs in the samples collected at ten miles. The activity in the samples is from five to ten times the background levels found in vegetation collected throughout the Southwest. (auth)

27257 (MLM-2085) INTERIM ENVIRONMENTAL MONITORING REPORT, JANUARY–JUNE 1973. Carfagno, D. G.; Westendorf, W. H. (Mound Lab., Miamisburg, Ohio). 31 Aug 1973. Contract AT-33-1-GEN-53. 21p. Dep. NTIS $4.00.

The environment surrounding Mound Laboratory was monitored, and the results for the first half of 1973 are reported. The average concentrations of polonium-210, plutonium-238, and tritium measured in air and water samples were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. The results of the analyses of foodstuffs and soil samples for radioactive species, as well as the results of analyses of all samples for nonradioactive species, will be presented in the year-end Annual Environmental Monitoring Report. (auth)

27258 (ORNL-TM-4318) HOME VENTILATION RATES: A LITERATURE SURVEY. Handley, T. H.; Barton, C. J. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

A survey was made of published ventilation rates because this parameter has an important effect on doses to home occupants from airborne radionuclides. The survey was devoted primarily to information on ventilation of single housing units located in the United States including techniques used to measure the ventilation rate. Helium was found to be the most commonly used tracer gas. The available data suggest that the average annual ventilation rate of most occupied houses falls in the range 0.5 to 1.5 air changes per hour. It is recommended that this range be adopted for calculations of doses resulting from home exposure to airborne radionuclides. Inclusion of apartments in modern high-rise buildings would raise the recommended upper limit to 2.0 air changes per hour if all ventilation air is from outside the building. (29 references) (auth)

27259 (UCRL-74392) WIND-DRIVEN REDISTRIBUTION OF SURFACE-DEPOSITED RADIOACTIVITY. Anspaugh, L. R.; Phelps, P. L.; Kennedy, N. C.; Booth, H. G. (California Univ., Livermore. Lawrence Livermore Lab). 11 May 1973. 16p. (CONF-730503-7). Dep. NTIS $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973).

The deposition of radionuclides on a terrestrial surface can result in the delivery of dose to man through external radiation exposure, food chain contamination, or inhalation of suspended particles. Plutonium-239 is one of the few radionuclides generally regarded as constituting an inhalation hazard through wind-driven resuspension. No adequate models of resuspension exist. Two major problem areas have been identified: the rate at which initially deposited debris weathers into a less erodible state as a function of time, and a source term factor in material removed per unit time per unit area, applicable to a source of any configuration. Concentrations in air of particles moving in suspension were studied over a period of six weeks following the nuclear cratering event Project Schooner and over a 10-month period following accidental venting of an underground nuclear explosion. Suspended air activity was observed to decrease in time with half-times of 35 to 80 days; this factor appears to be much more important than variations in meteorological parameters over these relatively short time periods. Movement of small particles in suspension accounts for only a minor fraction of the total mass movement. As much as 50% of the initially deposited debris was moved by saltation within a 24-hour period. Such movement can result in extensive microinhomogeneities with accumulation of debris under bushes or other places affording shelter from erosive forces. More detailed study of the resuspension process in an aged ^{239}Pu field is now in progress. Preliminary data are given on the particle size distribution of the total mass and the ^{239}Pu moving in suspension. (auth)

27260 THEORY OF THE VERTICAL DISTRIBUTION OF NATURAL RADIOACTIVITY IN THE ATMOSPHERIC BOUNDARY LAYER. Styro, B. I.; Amiranashvili, A. G.; Okroashvili, G. G.; Khundzhua, T. G. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 2, 349-351(Aug 1973). (In Russian).

A theoretical computation of the vertical distribution of natural atmospheric radioactivity due to radon and thoron under the assumption of a stationary condition and for various cases of altitudinal distribution of the turbulent diffusion coefficient, K_z, is suggested. With the help of a computer, the ratio of radon and thoron concentrations in the atmospheric boundary layer to their concentrations at 1 m level in % for the stationary atmospheric stratification at different values of K_z was obtained. (auth)

27261 SEASONAL VARIATION OF ATMOSPHERIC RADIOACTIVITY AT IBADAN. Sanni, A. O. (Univ. of Ibadan, Nigeria). Tellus; 25: No. 1, 80-85(1973).

The results of regular monitoring of air samples for radioactivity at Ibadan for the period July 1966 to February 1967 are presented here. The results show a general increase of atmospheric specific radioactivity and particular periods of high atmospheric specific radioactivity during the Harmattan season. The general increase in atmospheric specific activity is not correlated with nuclear weapons tests and is explained in terms of the enhanced exhalation of emanation from the Earth's crust. The prominent peaks of atmospheric specific radioactivity are shown to correlate with severe Harmattan days, characterized by high specific volume of water vapour in the atmosphere. The prominent peaks of atmospheric specific radioactivity during the Harmattan months are attributed to the continental north-easterly winds which transport radioactive dusts from the radioactive fields of Niger Republic and of the plateau regions of Nigeria to the station of observation. (auth)

27262 TRITIUM AIR SAMPLING METHOD FOR ENVIRONMENTAL AND NUCLEAR PLANT MONITORING. Osloond, J. H.; Echo, J. B.; Polzer, W. L.; Johnson, B. D. (Atomic Energy Commission, Idaho Falls, ID). pp 531-533 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A method for monitoring tritium is described consisting of directly counting tritiated moisture adsorbed on silica gel. The measurement of tritium oxide air concentration provides a realistic evaluation of nuclear plant or environmental conditions. (DHM)

27263 SAMPLER FOR NONAQUEOUS TRITIUM GASES. Griffin, W. R.; Cochran, J. A.; Bertuccio, A. A. (Environmental Protection Agency, Winchester, MA). pp 533-541 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Laboratory and field testing proved the nonaqueous tritium sampler to be an efficient, simple to operate, durable, and reliable device. All substances tested to date were successfully oxidized in the burner. Its stability and simplicity of operation allow it to be run for long periods of time with little or no supervision; 73 days of continuous operation required only weekly spot checks. It has good reliability because it uses simple mechanical and chemical action instead of complicated electronics which often are temperamental when used in the field. Finally, this nonaqueous tritium sampling capability can be added at small original cost to laboratories already having the capability to measure HTO. The parts of the sampler can be purchased and/or fabricated for less than $300. The costs of operation for carrier gas and desiccant are variable and dependent on frequency of operation. (auth)

27264 MECHANISMS OF TRANSPORT IN THE ATMOSPHERE. pp 87-117 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Basic principles are reviewed by which calculations are made of diffusion and deposition of radioactive contaminants released to the atmosphere. Topics considered include: properties of the atmosphere (diffusion in the friction layer from a continuous-point source; effective stack height; effect of buildings and terrain on plume dispersion; diffusion of accidental release in lower atmosphere; and dispersion of aerosols); deposition of particulate effluents (impaction of dust on surfaces, and wind pickup of deposited particles); dose calculations from radioactivity in the atmosphere (external γ dose from passing cloud, β dose from passing cloud, and dose to lungs); and tropospheric and stratospheric behavior. (DHM)

27265 NATURAL RADIOACTIVITY. pp 159-204 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

Topics considered include naturally occurring radioactive substances, natural sources of external ionizing radiation, man-made modifications of the natural radiation environment, areas having unusually high natural radioactivity, and summary of human exposures to natural ionizing radiation. (DHM)

27266 TRITIUM AND DEUTERIUM CONTENT OF THE SNOW IN GREENLAND. Merlivat, L. (CEN de Saclay, Gif-sur-Yvette, France); Ravoire, J.; Vergnaud, J. P.; Lorius, C. Earth Planet. Sci. Lett.; 19: No. 2, 235-240(Jun 1973).

Deuterium and tritium measurements were made on firn samples taken along a central axis across Greenland. Accumulation values determined from tritium profiles decrease regularly from 54.7 cm of water per year on the west coast to 18.1 cm of water per year on the east coast. A correlation is demonstrated between the tritium deposition rate and the altitude of the precipitation collection site. (auth)

Soil

27267 (CONF-710501-P1, pp 129-132) DISTRIBUTION OF CESIUM-137 IN A SMALL WATERSHED IN NORTHERN MISSISSIPPI. Ritchie, J. C.; McHenry, J. R.; Gill, A. C.; Hawks, P. H. (Dept. of Agriculture, Oxford, MS). 1971).

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Concentration of fallout ^{137}Cs in soils and sediments of a small watershed in north Mississippi was measured to determine the redistribution of fallout ^{137}Cs. Measured concentration of ^{137}Cs ranged from 8.9 nCi/m^2 in soils from actively eroding areas to 412.2 nCi/m^2 in conservation pool sediments. A model was constructed for the distribution of ^{137}Cs in the watershed. Sixty-one percent of the ^{137}Cs in the conservation pool sediments was derived from the movement of ^{137}Cs from the contributing watershed. Of the ^{137}Cs moved from the watershed, 53% was contributed from the eroded areas that presently occupy 4% of the contributing watershed area. The efficiency of the reservoir for trapping or retaining ^{137}Cs carried into it from runoff was 57%. Of the total ^{137}Cs deposited in the watershed, less than 7% moved from the contributing watershed and only 3% of the ^{137}Cs deposited in the watershed moved through the reservoir outlets. (auth)

27268 (CONF-710501-P1, pp 140-149) CESIUM-137 SOIL INVENTORY OF A TAGGED LIRIODENDRON FOREST 1962 AND 1969. Francis, C. W.; Tamura, T. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The soil has become a major sink for ^{137}Cs inoculated into Liriodendron in 1962. The distribution of this radionuclide within the soil profile and among soil fractions was determined in soil samplings of late fall 1962 and summer 1969. The much higher concentration of ^{137}Cs in the clay fraction (1962 samplings) at a soil depth of 6 cm (11.1 pCi/mg) as compared with that at 4 and 9 cm (4.8 and 1.1 pCi/mg respectively) indicates that most of the inoculated ^{137}Cs entered the soil through the roots rather than by transfer from rainfall or litter fall. This conclusion is also supported in that soil (<0.250 mm) separated from fine roots by ultrasonics contained nearly twice the ^{137}Cs concentration to that separated from bark, small stones, etc. The 1969 soil sampling indicated that some downward accumulation of ^{137}Cs occurred after 1962; for example, the concentration at a soil depth of 14 cm (0.67 pCi/mg) in 1969 was higher than the 0.31 pCi/mg determined at a depth of 9 cm in 1962. Also, in the 1969 sampling there was no evidence of a ^{137}Cs concentrating phenomenon at the 6-cm depth as there was in the 1962 sampling. Separates obtained through density gradient zonal centrifugation indicated greater than 90% of the ^{137}Cs on soil is associated with the mineral soil components. Of the mineral component, the bulk of the ^{137}Cs appears to be associated with the predominant soil clay minerals, kaolinite and chlorite; however, there does seem to be a certain amount of selective concentrations of ^{137}Cs in the micaceous minerals. (auth)

27269 (CONF-710501-P1, pp 209-211) RADIOACTIVE STRONTIUM AND CESIUM IN CULTIVATED AND ABANDONED FIELD PLOTS. Cline, J. F.; Rickard, W. H. (Battelle Pacific Northwest Labs., Richland, WA). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Strontium-90 and ^{137}Cs added to surface soil of small field plots 16 and 8 years ago, respectively, were measured in soil and plants. Five years ago these plots were abandoned and allowed to be naturally colonized by the annual weeds, cheatgrass and mustards, characteristic of early secondary succession in the steppe region of southeastern Washington. After 16 years, ^{90}Sr remained available for plant uptake. The major loss of ^{90}Sr from the plots was attributed to physical decay. Less than 2% of the estimated loss could be assigned to plant harvest and cultured practices. After eight years, 70% of the added ^{137}Cs remained in the upper inch of untilled soil. In tilled soil, ^{137}Cs was concentrated at the tillage layer depth of 5 to 6 in. Strontium-90 was distributed throughout the upper 10 in. of untilled soil and tended to form an accumulated front at 4 to 5 in. deep after 16 years. In the tilled soil, ^{90}Sr was scattered throughout the upper 10 in., and some had probably moved into the gravel lying below 10 in. (auth)

27270 (CONF-710501-P1, pp 212-217) INFLUENCE OF WATER REGIME ON THE INDIRECT ABSORPTION OF RADIOCESIUM, RADIOSTRONTIUM, AND RADIOCOBALT BY LOWLAND RICE. Myttenaere, C.; Marckwordt, U. (European Atomic Energy Community, Ispra, Italy). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

On radionuclides in ecosystems.

Rice soils retain a high percentage of radionuclides transported by irrigation water. The accumulated radioactivity can partly be released to the roots of lowland rice. In order to establish the influence of water regime on the indirect radiocontamination of rice, the availability in soils and the absorption by plants of ^{134}Cs, ^{85}Sr, and ^{60}Co were studied during three successive years (1967, 1968, 1969), using the same variety in flooded and nonflooded conditions. The experimental conditions of the rice culture in lysimeters were checked with data collected in an irrigated rice field. Radiostrontium and radiocesium absorption by plants was not greatly influenced by the different water regimes. Radiocobalt level of plants was found to be considerably higher in flooded rice and thus reflected the increased availability of Co in flooded soils. Concentration factors varied with the radionuclide and the plant organ. The variations in specific activity of radioisotopes in the plant underline a different behavior of the radioactive and stable isotope in the soil. In conclusion, under our experimental conditions, only cations, the solubility of which depends directly on the redox state of the soil, were more available and were taken up by the rice plants. (auth)

27271 (CONF-710501-P1, pp 218-224) CALCIUM CYCLING: DIFFUSION INTO A FOREST SOIL. Grigal, D. F. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Calcium-45 was introduced into red maple (Acer rubrum L.) trees in spring, and the leaves were harvested in autumn and laid on the floor of an oak-hickory forest. Movement of ^{45}Ca from the leaves into other components of the ecosystem, and particularly into the soil and soil-water systems, was monitored for two winters and the intervening summer by periodic sampling of soil, litter, and soil-water. After 72 weeks, approximately 50% of the ^{45}Ca had moved into the soil. Activity of the isotope decreased exponentially with depth and little had moved below 20 cm. Some of the isotope had also cycled through the surrounding vegetation and back to the soil surface. The ^{45}Ca did not move into the soil in solution but instead moved by surface or exchange diffusion along the soil particles. A grain-boundary diffusion model, which infers rapid diffusion along pores and slow diffusion into soil peds, was used to predict this movement. The ^{45}Ca initially introduced into the system is accounted for by that observed in the litter and

that predicted by the model in the soil. The results imply that studies that emphasize soil solution, as with tension lysimeters, may not provide sufficient information with which to describe movement of naturally incorporated cations from leaf litter into soil. The results further indicate that after introduced fertilizer cations are initially fixed either chemically by the soil or biologically by the macro- and microflora, losses of such cations from the system are likely to be small. (auth)

27272 BEHAVIOR OF TRITIUM IN THE SOIL. Stewart, G. L. (Univ. of Massachusetts, Amherst). pp 462-470 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Because of the characteristics of the clay–water system, tritium fractionation occurs as tritium in bulk pore water exchanges with water in different physical states and with hydroxyl groups. Both thermodynamic theory and experimental data suggest that tritium fractionation is small as isotopic exchange occurs between the bulk pore water phase and the tenaciously adsorbed water phase. Isotopic exchange occurs between hydrogen in adsorbed water and crystal lattice hydroxyls for all clay minerals and soils studied. A few samples of illite and Davidson clay showed high exchange rates and suggested that considerable tritium fractionation may occur. The conditions and/or factors responsible for this high exchange are not known. Many practical hydrologic investigations will not require that corrections be applied to experimental data for the isotope effect of tritium because other factors associated with water flow are more significant. (auth)

Water

Refer also to abstract 29470.

27273 (AAEC/LIB/Bib-392) RADIOSTERILIZATION OF PHARMACEUTICALS. A Bibliography, 1962–1972. Geue, P. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

Fifty-four references deal with reviews and radiation technology, 52 with pharmaceutical chemicals and formulations, 23 with antigens and vaccines, 9 with antibiotics, and 31 with industrial aspects. Arrangement is chronological by year within each section, and alphabetical by author within each year. The period covered is 1962 to 72, and, where applicable, reference is made to abstracts for citations in NSA. The bibliography does not include microbiological aspects, packaging, or biological tissues and fluids. (AT)

27274 (BNWL-1751(Pt. 2), pp 12-13) RADIONUCLIDE CONCENTRATIONS IN THE ATLANTIC OCEAN. Silker, W. B. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The rates and mechanisms of the chemical and mixing processes in the ocean are being investigated using oceanic distributions of cosmogenic ^{7}Be, fallout radionuclides, anthropogenic pollutants, and natural tracers. Increased areal coverage has been afforded by the National Oceanic and Atmospheric Administration whose personnel have conducted surface water sampling during scheduled cruises of the NOAA fleet. These studies provide increased understanding of the factors governing air-sea exchange processes and the subsequent diffusive and advective transport in the oceanic regime. (auth)

27275 (BNWL-1751(Pt. 2), pp 13-14) RADIONUCLIDE CONCENTRATIONS IN THE PACIFIC OCEAN. Silker, W. B. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Surface water samples were obtained during two transects of the North Pacific Ocean, the first was from Seattle, Washington to Hong Kong in March and the second was from Taiwan to Seattle in June, 1972. The concentrations of cosmogenic ^{7}Be decreased in a regular fashion with decreasing latitude between 47° and 20° N. An area of higher but uniform surface concentrations of ^{7}Be was observed in the Philippine and South China seas in the region bounded by 20° to 23° N and west of 140° E longitude which averaged 160% of the concentrations measured in the open ocean east of this region. This condition was not observed when ^{95}Zr^{95}Nb was introduced into the atmosphere from a March nuclear weapons test, thus the increased ^{7}Be values probably did not result from a local condition of increased air-sea transfer. This area in the Philippine and South China seas is within the influence of the Kuroshio Current. It seems likely that this strong current could transport water from the region of higher fallout at the intertropical convergence to the south, and therefore, could explain the observed concentration differences. No fallout from the March 17 Chinese detonation was observed during the March sampling leg, however, it was observed in all samples obtained in June, which were collected as far south as 23° N latitude. Concentration boundaries exist between the two major current systems observable with ^{7}Be, but masked in the case of ^{137}Cs due to long term mixing processes and near term ^{137}Cs fallout which represents only a small increase above the large existing inventory. (CH)

27276 (BNWL-1751(Pt. 2), pp 14) LONGITUDINAL CONSISTENCY OF SURFACE WATER ^{7}Be CONCENTRATIONS. Silker, W. B. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Surface water concentrations of ^{7}Be in sets of seawater samples collected along relatively narrow latitude belts of the Atlantic and Pacific Oceans over the past several years were analyzed to evaluate variability. Very little variation was noted between samples within a set taken along a given latitude belt. In fact, the standard deviation within a given data set ranged from about 10 to 15%. This constancy, thus, permits estimation of fallout in large segments of the ocean from only limited analytical data. It must be remembered, however, that abnormal fallout patterns exist, for example, in several geographical locations such as at the intertropical convergence, in regions of low rainfall such as the area west of the African coast, and within the Peru Current in the South Pacific. (CH)

27277 (BNWL-1751(Pt. 2), pp 15-16) COMPUTATION OF TRACER DISTRIBUTION IN NORTH PACIFIC OCEAN. Petersen, M. R. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The oceanic distribution of natural and fallout radionuclides has provided new insights into the temporal and spatial scales of mixing and advection processes in the ocean and of transfer in the marine biosphere. The interaction of physico-chemical and physico-biological processes form an important part in understanding general oceanic problems and the use of tracer distributions. A scattered collection of circulation data is available. To make the best possible use of these data, a dynamic circulation model was developed for use in predicting movement of long-lived fallout radioisotopes in the ocean. The model was used to investigate the input and movement of ^{137}Cs at 3-month intervals in the North Pacific up to a total time of 2 years. For these initial computer simulations, input of ^{137}Cs was only across the air-sea interface and no tracer was allowed to escape. The input was assumed to be latitudinally constant and to be proportional to its measured air concentration. The input rate was proportional to that of the short-lived radionuclide ^{7}Be. The velocity field was assumed to have an annual cycle with the surface velocities of February, May, August and November being taken as the average surface velocity for that season. The results of these computations showed that the general latitudinal variation in the ocean mirrored that of the atmosphere. (CH)

27278 (BNWL-1751(Pt. 1), pp 48-49) IRON-55 CONCENTRATIONS IN MARINE AEROSOLS AS A FUNCTION OF LATITUDE. Jenkins, C. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

As part of the effort to characterize physical and chemical mechanisms that contribute to the selective uptake by marine organisms of fallout ^{55}Fe relative to stable iron in the ocean and to the 10 to 30 fold higher ^{55}Fe specific activities in surface feeding fish in the north Pacific and Atlantic waters, marine aerosol samples collected on a north-south transect from Kodiak Island, Alaska to Honolulu, Hawaii, were analyzed for ^{55}Fe. In considering possible factors which would contribute to the selective uptake of fallout ^{55}Fe relative to stable iron in the oceans by marine organisms and to the large difference in specific activity, it was concluded that chemical and possibly physical factors are more likely to be responsible than the food web. (CH)

27279 (BNWL-1752) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JULY-DECEMBER, 1972. Kipp, K. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug 1973. Contract AT(45-1)-1830. 29p. Dep. NTIS $4.00.

An evaluation of ^{106}Ru and ^{3}H concentrations measured near the surface of the unconfined groundwater during the last half of 1972 showed that zones of detectable contamination extended in an easterly to south-easterly direction from 200-E Area, as has been observed in the past. Measurable tritium and nitrate ion concentrations were found along the Columbia River in the vicinity of the 100 Areas. A low groundwater mound showing uranium and nitrate ion continued to be observed in the 300 Area. The few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) of 10 pCi/ml for ^{106}Ru were within either the 200-E or 200-W Areas. Significant concentrations of ^{106}Ru (over 10% of CG) were found only in the 200 Areas. Gross beta activity in the groundwater beneath the 100 Areas was detectable only at the 100-N Area from the effluent discharge to the 1301-N crib. A concentration of ^{3}H that exceeded the Concentration Guide of 3000 pCi/ml (outside the area boundaries) was found in Well 699-35-70 (outside the south-east corner of 200-W Area) as has been noted previously. A moderate increase in tritium concentration levels and extent in the vicinity of 100-N area occurred during this report period due to processing of tritium bearing target elements. New data show that the tritium zone under the 100-F Area is separate from the plume that emanates from the 100-N Area. Nitrate ion concentrations greater than 10% of the Public Health Service (PHS) recommended drinking water standard of 45 ppM were observed in most groundwater samples from wells within and in the immediate vicinity of the 100-F, 200, and 300 Areas. However, groundwater from these zones is not consumed by humans or animals. The 10% of PHS recommended drinking water standard nitrate concentration zone now includes well 699-14-E6-T southeast of 200 East Area. There are no major changes in other isopleth contours since the previous report period (January-June 1972). Although water samples from several wells with piezometer tubes extending to deep aquifers were obtained and analyzed for tritium and nitrate ion during this report period, all samples had tritium concentrations less than the analytical limit of 1 pCi/ml and nitrate concentrations less than 1.5 mg/l. The one exception was well 699-59-80B, located just south of Gable Butte, whose average nitrate concentration increased from about 12 mg/l to 16 mg/l during this report period. An explanation of this occurrence is still being sought. (auth)

27280 (CONF-710501-P1, pp 460-464) STRONTIUM-90 AND CESIUM-137 IN WATER AND DEEP SEDIMENTS OF THE GREAT LAKES. Lerman, A. (Canada Centre for Inland Water, Burlington, Ont.); Taniguchi, H. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Input of ^{90}Sr into the Laurentian Great Lakes was estimated from the rates of deposition of nuclear fallout in atmospheric precipitation over the lake surface and land drainage basin of each lake, for the period 1954 to 69. The amount of ^{90}Sr accumulated in the sediments of Lakes Superior, Michigan, and Ontario is only a small fraction (2 to 6%) of the total amount introduced into the lakes. The amount of ^{137}Cs in sediment cores from Lakes Ontario and Superior is 20 to 35 times greater than the amount of ^{90}Sr. These high concentrations of ^{137}Cs, viewed against the value of 1.45 for the $^{137}Cs/^{90}Sr$ ratio in atmospheric fallout and 0.16 to 0.36 in the Great Lakes waters, indicate that Great Lakes sediments strongly control the concentration of ^{137}Cs in lake water. (auth)

27281 (CONF-710501-P1, pp 465-473) IRON, MANGANESE, COBALT, AND ZINC CYCLES IN A SOUTH CAROLINA RESERVOIR. Marshall, J. S.; LeRoy, J. H. (Savannah River Lab., Aiken, SC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The distribution of Fe, Mn, Co, and Zn and the sorption of radioisotopes of these elements by seston were studied during 24 months in Par Pond, a warm monomictic reservoir in South Carolina. The dissolved and particulate forms of these elements exhibit marked seasonal variation in the epilimnion; the annual maximum concentrations are late in the thermal stratification period (April to October) and early in the fall-winter overturn. The average percentages of elements that are particulate in surface water are: Fe (65%), Mn (86%), Co (22%), and Zn (15%). Particulate Fe, Mn, and Co associate principally with inorganic matter; particulate Zn does not. The average percentages of the particulate form of elements associated with net plankton are: Fe (1.2%), Mn (0.89%), Co (4.4%), and Zn (8.7%). The fraction of added ^{59}Fe that is retained by a filter with 0.45-μ pores after 24-hr in situ incubation closely approaches the fraction of total iron that is particulate; however, the sorption of ^{54}Mn, ^{57}Co, and ^{65}Zn is probably controlled by the age and concentration of the particulate manganese. (auth)

27282 (CONF-720597-1) USE OF THE CRITICAL NUCLIDE CRITICAL PATHWAY-CRITICAL POPULATION GROUP CONCEPT IN THE ESTABLISHMENT OF WATER QUALITY CRITERIA. Hespe, E. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). [nd]. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

From 5th annual Australian convention on water and waste water association; Adelaide, Australia (May 1972).

A concept, known as the critical nuclide-critical pathway-critical population group concept, is widely used in the setting of discharge limits for effluents containing radioactivity. The concept is described and its application in real situations is illustrated. It shows how the use of the concept for the setting of discharge limits involves also the establishment of criteria for the maintenance of the quality of the receiving waters and how the ideas implicit in the concept might be adapted to the establishment of discharge limits for nonradioactive polluting materials. (auth)

27283 MONITORING OF TRITIUM IN THE AQUATIC ENVIRONMENT OF POWER REACTORS. Porter, S. W. Jr. (Radiation Management Corp., Philadelphia). pp 517-521 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Many samples are presently below the level at which they can be directly measured without elaborate sample preparation and/or sample concentration (~400 pCi/l). For nuclear facility environmental monitoring programs, it is recommended that every three months a composite of like samples (such as surface water) be counted to an MDA of 50 pCi/l so that the actual activity will be known. This data (precipitation, surface, and well water) should be analyzed to calculate the tritium inventory and its movement through the regional hydrosphere utilizing precipitation rates and river flows. It is suggested that a comprehensive tritium sampling program be initiated at least two years prior to reactor start-up. This should give the utility an idea of seasonal variations of both surface water as well as the precipitation input. Continuous composite samples should be taken whenever practical. A coordinated program should include sampling of the local environments of all major tritium producers or users (power reactors, fuel reprocessing plants, tritium dial painting facilities). This program should be coordinated with the local state health departments and the Environmental Protection Agency Monitoring Network. (auth)

27284 DISTRIBUTION OF CESIUM-137 IN BRITISH COASTAL WATERS. Jefferies, D. F.; Preston, A.; Steele, A. K. (Ministry of Agriculture, Fisheries and Food, Lowestoff, Eng.). Mar. Pollut. Bull.; 4: No. 8, 118-122(Aug 1973).

The safe discharge of wastes into the sea depends upon achieving adequate dilution of the effluent, otherwise inshore biological reserves may be damaged. Water in the north-east Irish Sea can be identified because of its content of radioactive cesium emanating from the Windscale nuclear fuel processing plant. A survey shows how closely this water hugs the coasts as it travels across the Irish Sea and along the west and north coasts of Scotland. Inshore waters receive almost all our effluents and this report suggests that the dilution capacity of the sea may be far less than is supposed. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 27221, 27376, 27607, 27642, 27660, 27681–27683, 27685, 27687, and 27689.

27285 (ANL-7960(Pt. 3)) RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIVISION ANNUAL REPORT: JANUARY–DECEMBER 1972. (Argonne National Lab., Ill.). 1972. Contract W-31-109-eng-38. 163p. Dep. NTIS $7.60.

Separate abstracts were prepared for three sections of this report. (CH)

For abstracts of individual sections see: 27286, 27347, and 27687.

27286 (ANL-7960(Pt. 3), pp 1-6) GREAT LAKES RADIOECOLOGY: LEVELS AND DISTRIBUTION OF ^{137}Cs, ^{239}Pu, AND ^{90}Sr IN LAKE MICHIGAN. Marshall, J. S.; Edgington, D. N.; Spigarelli, S. A.; Wahlgren, M. A. 1972.

Radiological and Environmental Research Division annual report, January–December 1972.

Data are presented on the levels and distribution of fallout ^{137}Cs, ^{90}Sr, and ^{239}Pu in water, sediments, and representative fish species and plankton in Lake Michigan during 1972. Samples were collected at 25 stations throughout the lake. (CH)

27287 (BNWL-1751(Pt. 2), pp 10) FALLOUT RADIONUCLIDE DISTRIBUTION IN THE ALASKAN ARCTIC ENVIRONMENT. Jenkins, C. E.; Hedlund, J. D. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Because unusually high concentrations of both man-made and artificial fallout radionuclides occur in the Arctic environment, the effect and ultimate fate of these radionuclides must be known to assess their potential hazard to man and his food web. This is somewhat simplified by a relatively short and simple food web: lichen–caribou–man (wolf). Certain radionuclides such as ^{22}Na, ^{55}Fe, ^{65}Zn, ^{110m}Ag, ^{137}Cs, and ^{210}Po concentrate in the soft tissues on each level of the food chain while ^{54}Mn, ^{90}Sr, ^{210}Pb, ^{226}Ra and others are effectively blocked from further transport by deposition on the bone tissue. The γ-emitting radionuclides observed to be most effectively concentrated through the three trophic levels are ^{22}Na and ^{137}Cs. Natural occurring ^{210}Po appears in relatively high levels in the soft tissues of caribou, wolf, and man; with its parent ^{210}Pb, it appears to be a major contributor to the total radiation dose being received by Arctic residents. There appeared to be little decline in radioactivity on lichens in 1971 and 1972 indicating the rate of input approximately equals the rate of loss. (CH)

27288 (BNWL-1751(Pt. 2), pp 10-11) FALLOUT RADIONUCLIDE DISTRIBUTION IN AN ALASKAN FOREST ENVIRONMENT: RELATION TO TRANSPORT OF ^{137}Cs TO MAN VIA CONSUMPTION OF MOOSE FLESH. Jenkins, C. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

One of the major objectives of the Alaskan study is to characterize the behavior of fallout radionuclides and their ultimate fate in the environment. A second objective is to relate this to the yearly dose absorbed by man. An important natural food item in the diets of Alaskan residents is moose. These animals, which range over most of the state, are consumed by Arctic people as well as many other residents of the state. In a previous study of Olympic (Washington) elk and deer, ^{137}Cs muscle tissue concentrations were observed to be as high or higher than in Arctic caribou. In view of this, a limited number of samples in the food web of moose in a forest environment were obtained to assess the potential radiological hazard to man. The results of these investigations suggest that radionuclides in a forest environment behave quite differently from those in the Arctic region. Short-lived radionuclides on similar lichen and moss are two or threefold higher at a given time while ^{137}Cs concentrations are somewhat lower in the forest environs. Moose flesh and bone samples were collected and will provide basic information for evaluation of the radiological hazard of this important food web to Alaskan residents. (CH)

27289 (BNWL-1751(Pt. 2), pp 23-24) GEOSECS-II INTERCALIBRATION AND TESTING CRUISE. Robertson, D. E.; Silker, W. B. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

During the GEOSECS-II test cruise in the Northwest Atlantic Ocean, large-volume water sampling was conducted for measuring ^{7}Be and selected fallout radionuclides as tracers of ocean mixing. Vertical concentration gradients of ^{7}Be and ^{95}Zr–^{95}Nb in the water column provided values for the vertical eddy diffusion coefficient of 1.2 to 1.3 cm^2/sec through the top sixty meters of the thermocline. Lower values of the diffusion coefficient calculated from the longer-lived nuclides ^{106}Ru and ^{144}Ce suggest horizontal transport of the deeper water from areas of lower fallout levels. Temporal and spatial oceanic distributions of ^{7}Be were analyzed for use in predicting deposition of other radionuclides present in the atmosphere. (CH)

27290 (BNWL-1751(Pt. 2), pp 47-48) ^{55}Fe CONCENTRATIONS AND SPECIFIC ACTIVITIES IN NORTH PACIFIC MARINE ORGANISMS. Jenkins, C. E.; Langford, J. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The transfer of ^{55}Fe from fallout to man was investigated with special emphasis on the marine food web. Transfer in humans, including the dilution effect of stable iron, measured as a function of diet and sex. The behavior, transport, and fate of ^{55}Fe and stable iron in the marine biosphere was also measured as a function of concentration in air, seawater, and food species. (auth)

27291 (CONF-710501-P1) RADIONUCLIDES IN ECOSYSTEMS. Proceedings of the Third National Symposium on Radioecology, Oak Ridge, Tennessee, May 10-12, 1971. Nelson, D. J. (ed.). (Oak Ridge National Lab., Tenn.). 1971. 687p. Dep. NTIS $16.60.

Separate abstracts were prepared for 58 of the 86 papers presented in this volume of the symposium. The other 28 papers were presented in volume 25 of NSA as abstract numbers 32372, 37104, 37105, 37714, 37756, 37772, 37773, 37792, 37861, 39806, 41638, 41687, 41688, 41689, 41691, 44287, 44288, 46801, 46802, 49122, and in volume 26 as abstract numbers 4745, 6406, 9479, 9484, 19889, 22499, 38761, and 41162. (ERB)

For abstracts of individual papers see: 27230, 27256, 27267–27271, 27280, 27281, 27292–27303, 27326–27328, 27333, 27348–27361, 27607, 27608, 27624, 27634, 27672–27679, 27688, 27690–27694, and 29435.

27292 (CONF-710501-P1, pp 9-17) ECOLOGICAL APPROACH TO THE EVALUATION OF RADIOACTIVITY WITHIN THE MAN ENVIRONMENT ECOSYSTEM. Platt, R. B.; Ragsdale, H. L.; Shure, D. J. (Emory Univ., Atlanta). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Both a philosophy and a plan of action are presented for an ecosystem approach to the measurement and evaluation of radioactive nuclides in the environment. Methods currently in use are generally restricted to an analysis of those environmental components directly related to man. Yet man's welfare depends also on the long-range quality of his total environment. For example, it is becoming apparent that negative feedbacks to man originate in natural systems. Thus, the prediction and discovery of trends of environmental change must be based on the entire network of trophic and subsystem transfers. Irreversible environmental problems usually arise through couples among biotic sybsystems. Reversals of potential threats to man are least expensively made by understanding and regulating inputs to natural systems. Changes become irreversible or expensively reversible when detected in food chains coupled directly to man. Food chains are treated functionally as natural, recreational, and domestic, with each of these assigned to the primary environmental components, including man. Computer programming provides for data storage, systems analysis of the data with respect to base lines and trends, and both tabular and graphic data displays. (auth)

27293 (CONF-710501-P1, pp 30-36) RADIONUCLIDES IN THE ENVIRONMENT AT NUCLEAR POWER STATIONS. Kahn, B. (Environmental Protection Agency, Cincinnati). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The radionuclides that can be found in the environment of commercial nuclear power stations are indicated, problems of environmental surveilance are discussed, and topics of radioecological research in this area are suggested. The information on radionuclides in the environment is derived from radionuclide release data and routine environmental monitoring by the stations and from field studies at several stations. The results show that several radionuclides are readily detectable in the aquatic ecosystem at many or all stations. Measurement of radioactive gases in ground-level air at several stations can be used to determine dispersion of stack effluents in air. Little or no radioactivity from the stations has been found in the terrestrial ecosystem. (auth)

27294 (CONF-710501-P1, pp 81-107) GAMMA-EMITTING RADIONUCLIDES IN ALASKAN ENVIRONMENTS 1967–1970. Koranda, J. J.; Martin, J. R. (Univ. of California, Livermore). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Environmental samples were collected at several sites in Alaska to determine the present status of radionuclides in Alaskan environments, with special emphasis on Amchitka Island. Samples were obtained on Amchitka Island, in coastal Alaska near Anchorage, and in central Alaska in the Fairbanks area. Lichens, grasses, herbs, and shrubs were collected along the Amchitka Island to Fairbanks transect of Alaskan environments. Radionuclide concentrations were determined by scintillation crystal and solid-state gamma spectroscopy. Cesium-137 was the most abundant radionuclide found in the northern environments, with low but detectable concentrations of ^{155}Eu, ^{125}Sb, ^{144}Ce, and ^{54}Mn also being present. Fallout from recent Chinese tests produced increased levels of $^{95}Zr/^{95}Nb$ in the 1970 samples. Lichens have the highest concentrations of ^{137}Cs, but evergreen vascular plants also had ^{137}Cs concentrations in the same range as those found in lichens. Plants with an annual topgrowth, such as grasses, had low to nondetectable concentrations of radionu-

clides. These data describe radiometric base lines pertinent to current testing programs being conducted in the Aleutian Islands and relate those base lines to those occurring elsewhere in the high latitudes. (auth)

27295 (CONF-710501-P1, pp 116-122) RADIONUCLIDE BIOMAGNIFICATION IN COASTAL-PLAIN DEER. Jenkins, J. H.; Fendley, T. T. (Univ. of Georgia, Athens). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Muscle samples were obtained from over 1000 deer throughout the Southeast during the past five years and analyzed for radionuclides. Deer from the Lower Coastal Plain region had consistently higher levels of ^{137}Cs than deer from the Upper Coastal Plain, Piedmont, Central Plateau, and Mountain regions. In the Lower Coastal Plain, deer muscle average 45,000 pCi/kg of ^{137}Cs, with some specimens ranging up to over 150,000 pCi/kg. Animals from the other provinces averaged around 4000 pCi/kg. Evidence was obtained that ^{90}Sr is effectively transported through the Lower Coastal Plain environment also. Strontium values in deer were comparable to the values found in Arctic herbivores, while the ^{137}Cs values are higher than were found in the Arctic. Potassium deficiency in vegetation probably increases radionuclide bioaccumulation. Cropland vegetation is 20× higher in potassium and has only 1 to 3% as much radioactive cesium as forest and swampland vegetation. Bioaccumulation in wildlife may well become a classic example of radionuclide cycling. Data indicate that the sterile, sandy soils of the Lower Coastal Plain in combination with high water tables and some specific radionuclide-concentrating plants produce the conditions that result in biomagnification of ^{137}Cs and ^{90}Sr in deer. (auth)

27296 (CONF-710501-P1, pp 123-128) CESIUM-137 IN WHITE TAILED DEER AS RELATED TO VEGETATION AND SOILS OF THE SOUTHEASTERN UNITED STATES. Cummings, S. L.; Jenkins, J. H.; Fendley, T. T.; Bankert, L.; Bedrosian, P. H.; Porter, C. R. (Eastern Environmental Radiation Lab., Montgomery, AL). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Data are presented for ^{137}Cs in white-tailed deer and vegetation of the southeastern United States along with information as to the nature of the associated soils. The concentrations of ^{137}Cs in some of the vegetation were of sufficient magnitude to account for the ^{137}Cs concentrations found in the deer. The highest ^{137}Cs concentrations in deer were associated with the humic-gley soils along the Atlantic and Gulf Coasts. These soils are predominately sandy in nature and have relatively low fixing capacities. The concentrations of ^{137}Cs in the vegetation grown on the humic-gley soils under natural and controlled conditions were greater than from the gray-brown podzolic and red-yellow podzolic soils. (auth)

27297 (CONF-710501-P1, pp 133-139) PROPOSED MECHANISM FOR THE RECYCLING OF RADIOCESIUM IN FLORIDA SOIL PLANT SYSTEMS. Gamble, J. F. (Univ. of Florida, Gainesville). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Cesium-137 levels in Florida milk samples are five to six times higher than the United States average. There is no evidence to suggest that Florida has received unusually high amounts of fallout. The elevated levels are attributed to ecological concentration factors. Preliminary data of ecosystem compartments, part of a larger, detailed program, indicate that the mechanism responsible for the high, continued ^{137}Cs activity in the Florida biosphere is a combination of cycling within the plant vascular system and a mycorrhizal-plant root association that transfers nutrients directly from litter to the plant. The efficiency of the recycling is enhanced by the low natural fertility of the soils. The nature of the recycling is such that losses of cesium occur primarily in the fruit. In certain grazing situations, higher levels in beef and milk can be explained by the ingestion of palmetto fronds, palmetto berries, and acorns. A ^{137}Cs tracer study is described, and data are presented for ^{137}Cs levels found in selected soil and plant compartments from a sand pine–scrub oak community (Pinus clausa–Quercus chapmanii, Q. geminata, Q. myrtiflora) and from a mixed hardwood stand in north central Florida. (auth)

27298 (CONF-710501-P1, pp 187-189) ACCUMULATION OF ^{144}Ce BY HICKORY AND ^{60}Co BY BLACK GUM SEEDLINGS. Thomas, W. A. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Mockernut hickory (Carya tomentoda) trees accumulate the rare-earth elements, and black gums (Nyssa sylvatica) accumulate cobalt, resulting in foliar concentrations several orders of magnitude greater than those of other trees on the same site. To compare absorption rates, seedlings of these species and ones of red maple (Acer rubrum), tulip tree (Liriodendron tulipifera), and white oak (Quercus alba) were grown for 35 days in nutrient solution and in soil, both inoculated with ^{144}Ce and ^{60}Co. The "index of selective absorption," defined here as the amount (dpm) of isotope transported to aboveground plant parts per 100 ml of nutrient solution absorbed by roots, compensates for differences among individuals in the volume absorbed. The Carya index for ^{144}Ce significantly exceeds ($P < 0.01$) the values for the other species both in soil (Carya 6720 ± 1900; Acer 620 ± 90; Liriodendron 320 ± 50) and in solution (Carya 4590 ± 450; Acer 770 ± 430; Liriodendron 720 ± 350; Nyssa 650 ± 190; Quercus 170 ± 40) in spite of large variation about the means. An insufficient number of Nyssa and Quercus seedlings survived in soil to permit valid statistical analyses. Nyssa and Carya indices for ^{60}Co in solution both significantly surpass ($P < 0.05$) the indices for the other species but do not significantly differ from each other (Nyssa 5110 ± 950; Carya 4470 ± 890; Acer 990 ± 500; Quercus 780 ± 300; Liriodendron 410 ± 130). Comparison of the index between treatments, soil versus solution, shows no significant difference for any species for either isotope. (auth)

27299 (CONF-710501-P1, pp 204-208) EFFECTS OF LIGHT, TEMPERATURE, AND SOIL FERTILITY ON DISTRIBUTION OF MANGANESE-54 AND CESIUM-137 IN PRODUCER–CONSUMER MICROCOSMS. Witkamp, M.; Merchant, V. A. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Environmental effects on mineral accumulation in compartments of producer-consumer microcosms were assessed using radioactive tracers. Manganese-54 and ^{137}Cs contents of grass, grasshoppers, and soil were measured weekly at two levels of light, temperature, and fertility. Magnitude and significance of the environmental variables and time on radionuclide accumulation were expressed in multiple regressions. Grass accumulated more ^{54}Mn than ^{137}Cs, while grasshoppers contained more ^{137}Cs than ^{54}Mn. Nutrient supply appeared to be the critical variable for plant development. Grasshoppers which had an adequate nutrient supply were affected primarily by temperature and light. Consequently, early nutrient depletion by grass and enhanced consumption by grasshoppers at the high levels of light and temperature resulted in lower radionuclide contents in the standing crops than at the low levels of light and temperature. (auth)

27300 (CONF-710501-P1, pp 225-231) RADIOTRACER STUDIES OF NUTRIENT CYCLING PATHWAYS. Stark, N. (Univ. of Nevada, Reno). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Studies on the depth of efficient ^{32}P uptake by second-growth and climax vegetation show that Cecropia peltata, a second-growth dominant, can absorb nutrients easily from 1 m or more in depth, while Guarea trichilioides, Dacryodes excelsa, and Piper blattera of the climax forest have shallow feeder roots. These findings support the theory that second-growth plants on poor tropical soils act as nutrient concentrators after disturbance. Young Sloanea berteriana and Manilkara nitida have deep feeder roots, but older specimens become shallow rooted and capable of ^{32}P uptake from 0 to 3 cm depth. In studies of the pathways of nutrient cycling using young seedlings and saplings of the climax forest with mycorrhiza, ^{59}Fe, ^{75}Se, and ^{65}Zn increased in level in the leaves and roots during the first month, probably as a result of surface leaching. Soil animals and free-living fungi that convert litter to humus are important agents in nutrient cycling on Puerto Rican latosols. Studies on functioning of direct nutrient cycling have not proved conclusively that this mode of nutrient transport does occur, but they do show that organic to organic cycling occurs. Research on the pathways of nutrient cycling is essential to understanding the influences of land management on the nutrient balance of any system. (auth)

27301 (CONF-710501-P1, pp 240-246) ORGANIC MATTER AND ^{137}Cs TURNOVER IN FOREST SOIL BY EARTHWORM POPULATIONS: APPLICATION OF BIOENERGETIC MODELS TO RADIONUCLIDE TRANSPORT. Reichle, D. E. (Oak Ridge National Lab., TN); Crossley, D. A. Jr.; Edwards, C. A.; McBrayer, J. F.; Sollins, P. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A bioenergetic model was developed that describes the dynamics of an earthworm population and its role in the cycling of organic matter and litter-incorporated ^{137}Cs into the soil. Long-term research on the dynamics of ^{137}Cs in a Liriodendron forest ecosystem has demonstrated the soil system to be a major repository for ^{137}Cs. Soil has slow exchange of ^{137}Cs with other components of the ecosystem. Earthworms (primarily Octolasium) dominate the soil invertebrate biomass and significantly influence the rate of breakdown of soil organic matter and the accompanying release of bound elements. Seasonal analyses of the abundance and biomass of earthworms in a ^{137}Cs-tagged forest enabled partitioning of total ^{137}Cs between earthworm tissue, soil organic, and mineral-bound fractions. Data also were obtained on efficiencies of ^{137}Cs assimilation by earthworms from both soil and litter, and on the biological turnover of ^{137}Cs body burdens. (auth)

27302 (CONF-710501-P1, pp 323-327) FATE OF COBALT-60 IN A NATURAL FRESHWATER ECOSYSTEM. Ophel, I. L.; Fraser, C. D. (Chalk River Nuclear Labs., Ont.) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Perch Lake is a small dystrophic-eutrophic lake on the property of Atomic Energy of Canada Limited at Chalk River, Ontario. For seven years it has been receiving at a relatively constant rate small amounts of ^{60}Co via its inlet stream, resulting in low, but measurable, concentrations of this radionuclide in the lake water. During this time water and food-chain components were assayed for ^{60}Co content using a large-volume counter combined with a single-channel gamma spectrometer. Concentration factors were determined for the dominant species of aquatic plants, fish, and other biota. Large differences in accumulation were found between species of plants due to morphology of the plants and their location in the lake. Differences between fish species are correlated with their feeding habits. The vertical and horizontal distribution of radiocobalt in the bottom sediments was investigated. Most of the nuclide is confined to the upper few centimeters of the organic-rich deposits. Calculations indicate that the lake sediment is an important storehouse of cobalt and that approximately 30% of the ^{60}Co that has entered the lake is now resident on the bottom. (auth)

27303 (CONF-710501-P1, pp 334-343) RADIOCESIUM DISTRIBUTION IN WATER, SEDIMENT, AND BIOTA IN HUDSON RIVER ESTUARY FROM 1964 THROUGH 1970. Wrenn, M. E.; Lentsch, J. W.; Eisenbud, M.; Lauer, G. J.; Howells, G. P. (New York Univ., NY). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The spatial and temporal distribution of ^{137}Cs and ^{134}Cs was measured in fish, plants, water, and sediments of the Hudson River Estuary along an 80-mile stretch of the river, encompassing salinities from one-fifth seawater to fresh water, in order to better understand the cycling of this radionuclide in an estuarine environment. Since the major route of exposure to man in this environment is through consumption of fish, a model was developed to predict the average amount in fish, which depends upon the average concentration of radiocesium in water and in sediments. Although the ^{137}Cs content of Hudson River water has dropped tenfold since 1964, the average content in fish and sediments has remained relatively constant. This implies that the ^{137}Cs content of fish resident in the river has depended primarily on the cumulative deposit in the sediments. The major source of this ^{137}Cs has been fallout, although in a limited section of the river an elevation of ^{137}Cs in sediments from the Indian Point nuclear plant can be seen. In order of decreasing content, ^{137}Cs was found in sediments, aquatic plants, and fish, roughly in the ratios of 30:1:1. The average content of radiocesium in fish has shown strikingly little variation from year to year, from a minimum of 20 pCi/kg in 1967 to a maximum of 56 in 1969. Cesium-137 was measured in 16 species of fish and is generally an order of magnitude lower than ^{137}Cs content of fish from lakes at this latitude. In relative terms, the highest concentrations of ^{137}Cs are found in the bottom feeding species such as catfish and suckers, intermediate levels in plant-eating species such as killifish, and the lowest levels in anadromous fish such as shad. Aside from the anadromous fish, the range of variability is about a factor of 3. (auth)

27304 (CONF-730814-4) ENVIRONMENTAL PATHWAYS FROM REACTOR TO MAN. Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1972. 26p. Dep. NTIS $3.50.

From 2nd international summer school on radiation protection; Herceg Novi, Yugoslavia (21 Aug 1973).

Environmental pathways for the transport of radionuclides in radioactive wastes from nuclear power plants to man are reviewed, with emphasis on migration through terrestrial food chains. The criteria of the ICRP for the identification of critical radionuclides, critical population groups, and pathways of radionuclide uptake are reviewed. Standards set by the ICRP and by the USAEC for permissible levels of radionuclide uptake by the general population are compared. (CH)

27305 (IRS-W-6) ENVIRONMENTAL VARIABLES INVOLVED WITH THE ESTIMATION OF THE AMOUNT OF ^{131}I IN MILK AND THE SUBSEQUENT DOSE TO THE THYROID. Hoffman, F. O. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Jun 1973. 58p. Dep. NTIS (U. S. Sales Only) $5.00.

Environmental aspects involved in the transport of ^{131}I through the grass–cow–milk pathway to the human thyroid are reviewed in order to recommend values to be used within the FRG for estimation or prediction of the accumulated dose received during normal operation of a nuclear installation. Applying these recommended values to suggested dose limits reveals that an above ground air concentration of approximately 2.7×10^{-14} Ci/m^3 of inorganic ^{131}I will result in an average milk concentration of about 4.3×10^{-14} Ci/liter and a maximum annual accumulated thyroid dose to the "critical child" of 90 mRems. An above ground air concentration of approximately 45×10^{-14} Ci/m^3 results in an average milk concentration of 71×10^{-11} Ci/liter and a maximum annual accumulated dose of 1.5 Rems. The accumulated life-time dose resulting from these air concentrations will be 1 and 17 rems, respectively. If these above ground air concentrations are composed of organic iodide-131, the resulting accumulated ingestion doses will be relatively insignificant due to the poor absorption of the organic iodides by vegetation. (GE)

27306 (SRO-641-8) RADIOACTIVE TRACER STUDIES OF SOIL AND LITTER ARTHROPOD FOOD CHAINS. Progress Report, November 1, 1972–October 31, 1973. Crossley, D. A. Jr. (Georgia Univ., Athens. Dept. of Entomology). 20 Jul 1973. Contract AT(38-1)-641. 40p. Dep. NTIS $4.00.

Field data and experimental results are given for studies on radionuclide and mineral element movement in arthropod food chains. Mineral element concentration was measured in a set of invertebrate species from a pine forest floor. Large concentrations of calcium were found in Cryptostigmata (oribatid mites), evidently localized in the exoskeleton. These mites may constitute a significant calcium reservoir in some habitats. Models for assimilation and accumulation of radioactive or stable elements were compared in laboratory experiments, in which the simplest model yielded the best results. Fallout ^{137}Cs was measured in a set of samples (1969) from a granitic outcrop habitat. Herbivorous arthropods averaged about 10 pCi per gm, about 50 percent of the ^{137}Cs concentrations in most plants species. Ratios of ^{137}Cs to K measured in these samples suggest that only the vascular plants, and perhaps the mosses, are serving as food for the herbivores. Lichens were depauperate in K, resulting in high Cs:K ratios. (auth)

27307 (SSI-1972-27) CORRELATION BETWEEN THE DEPOSITION OF ^{137}Cs AND CONTAMINATION OF MILK IN SWEDEN. Kraepelien, T. (National Inst. of Radiation Protection, Stockholm (Sweden)). Sep 1972. 10p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The correlation between ^{137}Cs deposition on pastures and contamination of milk was investigated. The concentration of ^{137}Cs in milk is given as a function of the deposition on pastures. Measurements were made of the contamination, and results are compared with calculated values. Deviations are shown in tables. (SW)

27308 (SSI-1972-32) INTAKE OF CESIUM-137 BY THE SWEDISH POPULATION DURING 1962 TO 1971 AS WELL AS AN ESTIMATION OF THE GENETIC POPULATION DOSE FROM RADIOACTIVE FALLOUT. Swedjemark, G. A. (National Inst. of Radiation Protection, Stockholm (Sweden)). Nov 1972. 30p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.50.

Radiation doses to the gonads from radioactive fallout depends on internally deposited ^{137}Cs and on external exposure. The amount of cesium-137 in the body is received primarily through food. An estimation of the intake has been done for 1962 through 1971. An investigation was done on the average for Sweden as a whole as well as for special areas. An estimation total amount of ^{137}Cs in the body was made from the intake per year and compared with results from whole-body counting. Doses to the gonads from radioactive fallout were estimated. Gonad doses from external irradiation was estimated from observed values. (SW)

27309 (SSI-1973-2) AMOUNT OF CESIUM-137 IN DAIRY MILK, 1972. Hagberg, N. (National Inst. of Radiation Protection, Stockholm (Sweden)). Feb 1973. 10p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The amount of ^{137}Cs and ^{40}K in milk has been controlled regularly since 1962. Samples are taken from 9 dairies distributed all over Sweden. The amounts registered for 1972 are listed and comparisons are made with earlier results. (SW)

27310 (SSI-1973-3) AMOUNT OF STRONTIUM-90 IN DAIRY MILK, 1972. Suomela, J.; Soerensen, A. (National Inst. of Radiation Protection, Stockholm (Sweden)). Jan 1973. 7p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The content of strontium-90 in dairy milk was measured during 1972. Samples were taken from nine dairies all over Sweden. The results are compared with earlier results. (SW)

27311 (SSI-1973-4) CONTENT OF CESIUM-137 IN SWEDISH REINDEER MEAT, 1972. Primary Data Report. Swedjemark, G. A.; Hagberg, N. (National Inst. of Radiation Protection, Stockholm (Sweden)). Feb 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

Measurements of the amount of ^{137}Cs in frozen reindeer meat have been made in Sweden since 1961. Samples have been requested twice a year from 13 regions. Only a very limited number of samples were obtained and therefore the errors of the average amounts are probably great. Tables of primary data from the measurements from 1972 and a summary of the results for the period since 1968 are given. (SW)

27312 (SSI-1973-5) CESIUM-137 IN THE CONTROL GROUP AT THE NATIONAL INSTITUTE OF RADIATION PROTECTION, 1972. Falk, R.; Eklund, G. (National Inst. of Radiation Protection, Stockholm (Sweden)). Jan 1973. 7p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

Measurements of the amount of ^{137}Cs in a control group, consisting of around 20 persons employed at the National Institute of Radiation Protection, have been done since 1959. The early measurements were done with an open-booth whole-body counter and the later ones with a three-crystal counter. The variation of the content of ^{137}Cs with time is shown. (SW)

27313 (SSI-1973-6) CORRELATIONS BETWEEN CESIUM-137 LEVELS IN MEAT AND MILK, 1972. Primary Data Report. Swedjemark, G. A. (National Inst. of Radiation Protection, Stockholm (Sweden)). Mar 1973. 4p. Dep. NTIS (U. S. Sales Only) $3.00.

The investigation into the correlation between the amount of ^{137}Cs in meat in relation to milk was continued during 1972. An equation is given for the relationship. The observed and calculated values are compared. The agreement is found to be quite good. (SW)

27314 (SSI-1973-7) RATIO BETWEEN CESIUM-137 AND STRONTIUM-90 IN MILK, 1972. Primary Data Report. Swedjemark, G. A. (National Inst. of Radiation Protection, Stockholm (Sweden)). Feb 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

It has been shown that the $^{137}Cs/^{90}Sr$ ratio in milk varies both geographically and with time. This Cs/Sr ratio is calculated as the ratio between pCi ^{137}Cs per gram potassium and pCi ^{90}Sr per gram calcium. (SW)

27315 (UCRL-74389) MODELING RADIATION EXPOSURES TO POPULATIONS FROM RADIOACTIVITY RELEASED TO THE ENVIRONMENT. Ng, Y. C.; Robinson, W. L.; Wilson, D. W. (California Univ., Livermore. Lawrence Livermore Lab). 11 May 1973. 14p. (CONF-730503-8). Dep. NTIS $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en Provence, France (14 May 1973).

Two approaches are used to estimate the potential population dosages (man·rem) per Curie release of cesium-137 in the United States from a hypothetical release of a fraction of the projected fission product inventory in 2000. One method involves a parametric analysis of relationships between fallout rates and cesium-137 in the various components of the diet. The other method is a pathways analysis using dose-to-man models of radionuclide transport in the environment and uptake in man. Both methods are applied to an input-output model of radionuclide flux through environmental compartments and man. Population characteristics are developed using census data and dietary habits. Man·rem per Curie estimates are developed for several food-chains and external exposures. External exposure from soil burdens contributes well over half of the man·rem, followed by terrestrial food-chains, with much lower contribution coming from aquatic food chains. Submersion and inhalation exposures from either the initial cloud or from resuspension are insignificant contributions. Calculations by the two methods are in good agreement. The man·rem per Curie estimates are used to order the importance of the various routes of exposure and to investigate the significance of contamination in various parts of the environment. (auth)

27316 (ZAED-BIBL.-2-11) CONTAMINATION AND DECONTAMINATION OF FOODSTUFFS. Fischer, E.; Strahlmann, B. (Zentralstelle fuer Atomkernenergie Dokumentation, Leopoldshafen (West Germany)). Jul 1973. 54p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

A bibliography is presented of 336 items under the headings general aspects, radioecology, contamination, and decontamination. Indexes to authors, subjects, conferences, and report numbers are included. (HLW)

27317 STUDIES ON THE FOOD CHAIN CONTAMINATION BY TRITIUM. Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium); Koch, G.; Adam, V.; Van Den Hoek, J. pp 341-348 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritiated water was deposited by spraying on approximately 7.5 acres (three hectares) of pasture and a series of experiments were performed on the uptake of tritium by pasture grass, grazing cattle, and milk constituents. Results showed that tritium was rapidly distributed in the environment but, at the same time it was diluted to a considerable extent with light water. Data are included from measurements of the tritium content in dry hay; root absorption from soil by grass; the effects of single and multiple applications of tritiated water on the distribution of tritium in grass, dry hay, and milk; the tritium content of hay components; and seasonal variations in tritium uptake from pastures and transfer to milk. (CH)

27318 TRANSFER OF TRITIUM FROM METHANE TO VEGETATION. Mason, B. J.; Hop, H. W.; Miller, C. L. (National Environmental Research Center, Las Vegas, NV). pp 455-461 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A study is reported that was designed to obtain information on the transfer of tritium from methane, the primary constituent of the gas from such projects as Gasbuggy, to vegetation. Mechanism of deposition of tritium from tritiated methane and from HTO is discussed. The large difference in uptake between the methane and the water vapor is thought to be primarily the result of the much slower rate of tritium exchange in the methane–water system than in the water–water system. (DHM)

27319 DYNAMIC MODEL OF WATER MOVEMENT IN SOIL UNDER VARIOUS CLIMATOLOGICAL CONDITIONS. Sasscer, D. S.; Jordan, C. F.; Kline, J. R. (Argonne National Lab., IL). pp 485-495 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The kinetic equation ecosystem model was applied to water movement in the soil of a tropical rain forest, an Illinois grassland, and a Nevada desert site. Results show that: (1) In the Puerto Rico rain forest, the most significant parameter controlling water (stable and tritiated) movement through the ecosystem is the rainfall. (2) In the Illinois grasslands, the rainfall and transpiration rate are the primary factors controlling water movement through the ecosystem. (3) In the Nevada desert, the half-residence-time is primarily influenced by the transpiration and diffusion rates. (4) In predicting long-term concentrations of tritium in the soil (other than possibly a tropical rain forest soil), it may prove an advantage to consider the tritium movement in the ecosystem as characterized by two separate half-residence-times. The initial value is determined primarily by the rate of transpiration and the final value, about an order of magnitude greater, is determined by the soil-water diffusion rate. (5) The ecosystem model, MESA, appears to be sufficiently general to give satisfactory predictions of water movement in a tropical rain forest, grasslands and desert soil. (auth)

27320 TRITIUM INTAKE IN NEW YORK CITY. Bogen, D. C.; Henkel, C. A.; White, C. G. C.; Welford, G. A. (Atomic Energy Commission, New York). pp 639-646 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

In an effort to establish base line amounts allowable for exposure to tritium by the general population, tritium was determined in three intake categories, diet, air, and fluids. Results

show that total tritium intake would be 2700 pCi/day or 0.99 Ci/a for the three modes of intake: diet–0.62 μCi/a; air–0.037 μCi/a, and fluids–0.33 μCi/a. (DHM)

27321 TRACE METAL CONCENTRATION FACTORS IN AQUATIC ECOSYSTEMS. Kneip, T. J.; Lauer, G. J. (New York Univ., NY). pp 43-62 of Chemical Analysis of the Environment and other Modern Techniques. Ahuja, S. (ed.). New York; Plenum Publishing Corp. (1973).

The basis is presented for the understanding of bioconcentration and concentration factors, and the (major) qualifying assumptions are discussed. A series of examples are presented which demonstrate the variations in the bioconcentration of trace metals. These examples include elements known or thought to be essential as well as those known to be adventitious, such as Cd, Cs, and Pu. The differences in the behavior of the metals demonstrate the problems inherent in general statements regarding concentration factors, and the reasons that many misuses have occurred. (auth)

27322 FOOD CHAIN FROM SOIL TO MAN. pp 118-136 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The migration of radionuclides from soil through the food chain to man is described. The metabolic transport of ^{90}Sr, ^{137}Cs, and ^{131}I through food chains is illustrated. Some properties of soils, radionuclide behavior in soils, and uptake from soils are also discussed. (ERB)

27323 AQUATIC ENVIRONMENT. pp 137-158 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The migration of radionuclides within aquatic ecosystems is described. The mixing characteristics in receiving waters, including oceans, coastal waters, estuaries, and rivers are discussed and the role of suspended solids and sediments is defined. (ERB)

27324 ^{210}Pb AND ^{210}Po CONTENT IN AIR, WATER, FOODSTUFFS, AND THE HUMAN BODY. Ladinskaya, L. (Inst. of Biophysics, Moscow); Parfenov, Y. D.; Popov, D. K.; Fedorova, A. V. Arch. Environ. Health; 27: No. 4, 254-258(Oct 1973).

Concentrations of ^{210}Pb and ^{210}Po in air, drinking water, foodstuffs, and human tissues are reported. The main route of ^{210}Pb and ^{210}Po intake in the human body is ingestion with foodstuffs. The absorption coefficient of ^{210}Po into the blood from the digestive tract was estimated to be 35%. The highest concentration of ^{210}Pb and ^{210}Po in the body was observed in the skeleton and hair. The body burden of humans was 773 pCi of ^{210}Pb and 513 pCi of ^{210}Po. Excretion of these radionuclides from the body in urine was 14 to 15 times less than in feces. The calculated annual radiation doses of ^{210}Po in the bone, liver, and kidneys were 2.1 to 5.0 millirad/yr, and in other soft tissues, 0.3 to 0.9 millirad/yr. (auth)

Radiometric Techniques

Refer also to abstracts 26970, 27030, 27300, 27537, 27545, 28630, and 29489.

27325 (BNWL-1751(Pt. 2), pp 67-68) APPLICATION OF THE ^{85}Kr MONITORING SYSTEM TO METEOROLOGICAL DIFFUSION EXPERIMENTS. Ludwick, J. D.; Nickola, P. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Tests, designed primarily to investigate deposition associated with particulate tracers or contaminants, are described, in which krypton and two particulate tracers, ZnS and Rhodamine B, are simultaneously released from the same elevation. The intent is to compare downwind exposures of the depositing particulates with the nondepositing inert gas krypton at successive downwind sampling areas. The anticipated depletion of the particulates can be ascribed to deposition. (DHM)

27326 (CONF-710501-P1, pp 253-259) RADIOACTIVE ISOTOPES IN STUDIES OF POPULATION DYNAMICS OF SMALL MAMMALS. Gentry, J. B.; Smith, M. H.; Beyers, R. J. (Savannah River Ecology Lab., Aiken, SC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Small mammals were snap-trapped on a 14.1-ha grid located in a lowland mesic-hardwood forest in South Carolina. The grid consisted of 26 lines and rows (676 trap stations) with 15-m intervals between stations. Prior to the start of trapping, all stations were prebaited for five days with radioactively labeled peanut butter. Then traps were set at each station on the centrally located 16 × 16 (36 stations prebaited with ^{59}Fe and 220 stations prebaited with ^{65}Zn) grid for 36 consecutive days. On day 18, traps were set at the remaining 420 stations (prebaited with ^{131}I) surrounding the 16 × 16 inner grid. Animals were taken to the laboratory and, with a pulse-height analyzer, checked for the presence of the three isotopes. The short-tailed shrew, Blarina brevicauda, was captured in the greatest numbers. Certain animals were difficult to capture; labeled animals were captured on days 21, 25, 30, and 36. Thirty-six percent of the animals captured on the 16 × 16 inner grid were labeled with two isotopes; 9% were unlabeled. Sixty-three percent of the animals removed from the outer band of the grid were labeled with one isotope; 32% were unlabeled. Animals were not equally distributed over the grid area, mainly because of changes in normal movement patterns due to prebaiting and removal trapping. The effects were evident in less than five days of trapping. (auth)

27327 (CONF-710501-P1, pp 265-273) RADIOISOTOPIC MEASUREMENT OF DEPTH AND DETERMINATION OF TEMPERATURES IN BURROWS OF HETEROMYID RODENTS. Kenagy, G. J. (Univ. of California, Los Angeles); Smith, C. B. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Methods of radioisotope detection through soils were developed and tested and it was found that it is possible to make a precise determination of the depth of small, fossorial, radioactively tagged animals in their burrows. By taking a profile of soil temperature at the burrow with a thermistor probe, it is also possible to determine the ambient temperature of the soil at the location of the animal in its burrow. The gamma attenuation in soil was investigated for four isotopes (^{60}Co, ^{24}Na, ^{64}Cu, ^{198}Au) by burying sources at depths to 1 m and measuring the radiation with a portable Geiger-Mueller survey meter. Appropriately irradiated sources can be located and accurate determinations made to 1 m. Several soils were compared, leading to some simple theory on shielding that can be used for applying the method to any soil. The method was applied to a study of the physiological ecology of two kangaroo rats (Dipodomys microps and D. merriami) and a pocket mouse (Perognathus longimembris), using ^{198}Au wires, but it is sufficiently general so that it can be employed with fossorial animals of different taxa. A model is introduced for estimating soil attenuation of gamma radiation for various soils and isotopes. (auth)

27328 (CONF-710501-P1, pp 401-409) PHYSICAL AND BIOLOGICAL DISPERSION OF THE HYPOLIMNETIC PHOSPHORUS OF A BOG LAKE SYSTEM. Hooper, F. F.; Imes, D. G. (Univ. of Michigan, Ann Arbor). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The phosphorous of the 7- to 8-m stratum of a Michigan bog lake was labeled with ^{32}P in the early spring of 1969 and 1970. In 1969 the label was applied through ice cover, and it spread horizontally throughout the 7- to 8-m stratum but moved very little vertically. The lake was meromictic in 1969, and the label remained in this part of the basin through the spring overturn and during the spring and summer. Isolation of the label in this stratum enabled study of biological transport in the absence of water movement. Larvae of the phantom midge Chaoborus carried radioactive phosphorus back and forth between the 7-m layer and the surface during their daily migration and appear to have liberated activity under the ice as a result of a heavy mortality in late spring. Little or no phosphorus was transported vertically from the hypolimnion by other species of zooplankton. In 1970 when there was normal thermal stratification, water of the same depth was labeled and it was found that ^{32}P was carried into the epilimnion during three periods of high vertical turbulence. The quantity of phosphorus carried into the 0- to 2-m stratum during these periods was from 22 to 45% of the total phosphorus present in this layer before mixing and constituted a major fraction of the large quantity of phosphorus remaining in the 6- to 8-m zone after spring overturn. Each pulse of the phosphorus carried into the trophogenic waters by mixing was rapidly taken up by bacteria and plankton and soon appeared in Chaoborus and in Umbra. Uptake curves for Umbra and plankton appeared to reflect these pulses. During daily migration, Chaoborus larvae fed upon radioactive phytoplankton and carried an average of 0.6 μg of phosphorus per larva downward into the hypolimnion. A portion of this phosphorus was lost to the bottom water by excretion. However, net downward transport by Chaoborus appeared to be small when compared with quantities brought up by turbulent mixing. (auth)

27329 DISTRIBUTION OF NUCLEAR FISSION NEUTRONS IN A QUASIHOMOGENEOUS MEDIUM CONTAINING URANIUM.

Davydov, Yu. B.; Markov, A. T. At. Energ. (USSR); 33: No. 1, 574(Jul 1972). (In Russian).

This paper was summarized as paper No. 595/6536 with full copy held by TIC.

The theory of nuclear fission neutron logging is considered for the case when the perturbing influence of the boreholes can be neglected. In a borehole passing through the medium under consideration, there is placed a point source of neutrons; the distribution of the nuclear fission neutron flux along the axis of the hole is desired. The diffusion approximation of neutron transport theory was used, and the solution was obtained by construction of the flux function for a plane source of fission neutrons with subsequent integration over the entire space of the source distribution. The results were utilized for the calculation of the neutron flux in a uranium-containing carbonate medium with a different porosity and a different degree of salinity of the water filling the borehole. An inversion effect was established for the nuclear neutron flux; it can be used to reduce the dependence of the results on the water content of the rocks. Calculations showed that the length of the inversion probe for the delayed nuclear fission neutrons differs little from the length of the inversion probe for the source neutrons. It was found that the recorded effect depends essentially on the type of probe, its length, the output of the active region, and the chemical composition of the medium. (3 figures) (RWR)

27330 TRITIUM HYDROLOGY STUDIES IN CALIFORNIA. Lventhal, J. S.; Libby, W. F. (Univ. of California, Los Angeles). pp 724-736 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Studies reported include Los Angeles County artificial recharge study and Sierra–Owens Valley run-off and recharge study. (DHM)

27331 EVALUATION OF Rb–Sr DATING METHODS APPLIED TO THE MATACHEWAN, ABITIBI, MACKENZIE, AND SUDBURY DIKE SWARMS IN CANADA. Gates, T. M.; Hurley, P. M. (Massachusetts Inst. of Tech., Cambridge). Can. J. Earth Sci.; 10: No. 6, 900-919(Jun 1973).

The ages of Canadian dike swarms were evaluated using Rb–Sr whole-rock data. Detailed studies of the Matachewan dike swarm show that in most cases Rb–Sr mineral isochron age values from individual samples are concordant with the Rb–Sr whole-rock age values for the dike swarm as a whole and are clearly greater than K–Ar age values on the same material. The fact that the mineral isochron ages and the whole-rock ages by the Rb–Sr method are similar suggests that there has been no significant thermal overprinting of these particular dikes since their emplacement and solidification or contamination by radiogenic ^{87}Sr from the host environment. Furthermore, the general scatter and lack of significant grouping of the lower K–Ar values similarly suggests that there was no single period of thermal resetting of the K–Ar ratios. It is observed that the K–Ar age values are greater in samples containing mica, and are more scattered and lower in samples in which potassium is contained in late-stage or principal phases other than mica. Therefore, it seems likely that significant loss of argon may result at near or normal surface temperatures and that the rate of diffusion is dependent on the mineralogy of the sample. It is concluded that reasonably good age determinations can be made on diabase dike rocks of ancient age by the Rb–Sr whole-rock isochron method, if the mineral isochrones are concordant. (auth)

27332 EXPERIMENTAL CHECK OF HYPOTHESES ABOUT THE ANNIHILATION AND THERMONUCLEAR NATURE OF THE TUNGUSKA EXPLOSION IN 1908. Kolesnikov, E. M.; Lavrukhina, A. K.; Fisenko, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 8, 1115-1121 (Aug 1973). (In Russian).

An experimental check of hypotheses about the annihilation and thermonuclear character of the Tunguska explosion in 1908 is suggested by means of measuring ^{39}Ar, which must be formed under the action of the neutron flux (in case these hypotheses are correct) from K and C in the rocks under the explosion epicentrum. In the investigated samples ^{39}Ar was not found, though the expected activity for samples taken nearest the epicentre must be by 2 orders higher than the sensitivity level of the low-background radiometric equipment used (0.01 dpm). These results testify against the nuclear nature of the Tunguska explosion. (auth)

Site Surveys

Refer also to abstracts 29238, 27368, and 27635.

27333 (CONF-710501-P1, pp 497-510) SOME ECOLOGICAL CONSIDERATIONS IN LOCATING A NUCLEAR-POWERED ELECTRICAL GENERATING FACILITY ON THE NORTH ANNA RIVER, VIRGINIA. Simmons, G. M. Jr.; Reed, J. R. Jr. (Virginia Commonwealth Univ., Richmond). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The North Anna River is a major tributary of the York River, which empties into the Chesapeake Bay. The ecological properties of a major portion of the North Anna River have been severely altered by more than 100 years of acid drainage from abandoned iron pyrite mines. Virginia Electric and Power Company is constructing a 13,000-acre impoundment within the disturbed area to provide cooling water for a 4,000,000-kW nuclear-powered electrical generating facility. Results from a preimpoundment study and inspection of the proposed reservoir construction and operation indicate that the facility will have a beneficial effect on the ecological properties of the lower North Anna River basin by accelerating the rate of recovery in the river below the dam. (auth)

27334 (COO-2138-11) INVESTIGATION OF EXPLOSION-INDUCED GROUND MOTION AND ITS RELATIONSHIP TO NATURAL SEISMICITY. Annual Technical Report. Willis, D. E.; Bufe, C. G.; Poetzl, K. G.; Shakal, A. F.; Tatar, P. J.; Torfin, R. D. (Wisconsin Univ., Milwaukee. Dept. of Geological Sciences). Jul 1973. Contract AT(11-1)2138. 104p. Dep. NTIS $7.25.

Major accomplishments achieved over the time period from July 1972 through June 1973 under sponsorship of the U.S. Atomic Energy Commission Contract AT(11-1)-2138 are summarized. Accumulative strain energy release maps for the area bounded by 35°N to 42.5°N and 113.5°W to 121°W were computed with a perspective representation for the time period 1852 to 1972. The area was divided into one-quarter degree grid units and the strain energy release was determined for each unit. A statistical study of the seismicity of the Nevada Test Site area was made for the time period May, 1969 through December, 1972. These studies indicate that the pattern of seismic activity induced by large underground tests has decreased to the point that by mid-1972 the activity probably reflects the level of the natural seismicity for the area. Little correlation appears to exist between seismicity and strain variations observed in the area using short-base strainmeters. On the basis of secular strain observations over a year or more, the axes of maximum extension at strainmeter sites in California, Nevada, and Utah trend north and west. Axes of maximum compression trend north and east. The seismicity and strain energy release were investigated for earthquakes located at distances out to 1000 km from the Nevada Test Site for 60-day intervals centered around the times of shots in the megaton range. No indication of increased seismic activity following the shots was found other than in the immediate area of the source. A detailed study of strong motion data and other close-in measurements did not substantiate the large suspected secondary source (that was based on late arriving Love waves) following CANNIKIN. Contoured maps of surface and body wave magnitudes were made for the North American Continent for the following Nevada Test Site shots: GREELEY, BOXCAR, BENHAM, JORUM, and HANDLEY. The high and low magnitude anomalies for these events were in general agreement with those reported earlier for the Amchitka events (LONGSHOT, MILROW and CANNIKIN). These data show clearly that regional corrections are necessary and that the standard magnitude equations probably employ an over-correcting distance function for this region. (auth)

27335 (DOCKET-701319-4) TEST AND RESEARCH REACTOR FUEL ELEMENT FABRICATION PLANT. Environmental Statement. (Directorate of Licensing (AEC), Washington, D.C.). Jun 1973. 135p. Dep. NTIS $8.75.

The final environmental statement for U.S. Nuclear fuel fabrication plant located in Oak Ridge, Tennessee is presented. Topics discussed include: site description, plant description, environmental effects of site preparation and plant construction; environmental effects of plant operation; environmental effects of accidents; unavoidable "adverse" effects; short-term and long-term effects of the facility; irreversible and irretrievable commitments of resources; costs and benefits of plant alternatives. (DHM)

27336 (LA-5386-MS) SEISMIC PROGRAM OF THE LOS ALAMOS SCIENTIFIC LABORATORY. Purtymun, W. D.; Jordan, H. S. (comps.). (Los Alamos Scientific Lab., N. Mex.). Sep 1973. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.

There are four areas of interest in seismic programs at Los Alamos: environmental studies, seismic studies in connection with the geothermal program, underground explosive test event studies, and strong motion studies. Areas of study and their objectives are outlined and a policy statement is proposed. (auth)

27337 (NILU-TN-14/71) PRELIMINARY EVALUATION OF METEOROLOGY AND DISPERSION CONDITIONS AT POSSIBLE NUCLEAR POWER PLANT SITES. Sivertsen, B. (Norsk Institutt for Luftforskning, Kjeller). Oct 1971. 19p. (In Norwegian). Dep. NTIS (U.S. Sales Only) $3.00.

An attempt is made to classify the potential nuclear power plant sites in the Oslofjord area according to the atmospheric recipient's capacity, and to the mean wind frequencies towards districts with high population density. The evaluation is based on data from the Meteorological Institutes' routine observations, supplemented by the Norwegian Air Research Institute's observations and those of Norsk Hydro in Telemark. (NO)

27338 (NILU-TN-16/71) PRELIMINARY EVALUATION OF METEOROLOGY AND DISPERSION CONDITIONS AT BRENNTANGEN ON THE OSLOFJORD. Sivertsen, B. (Norsk Institutt for Luftforskning, Kjeller). Nov 1971. 26p. (In Norwegian). Dep. NTIS (U.S. Sales Only) $3.50.

The dispersion conditions at the potential nuclear power plant site at Brenntangen on the Oslofjord are analyzed. The main climatic feature is the monsoon character of the wind, with cold NNE winds in the winter, and mild SSW winds in the summer. Daily variations are also discussed. Data is presented in the form of wind roses, graphs, and tables. (NO)

27339 (NILU-TN-21/72) EVALUATION OF LOCAL EFFECTS OF VARIOUS POSSIBLE NUCLEAR POWER PLANT SITES. Meteorology and Dispersion of Gaseous Effluents. Sivertsen, B. (Norsk Institutt for Luftforskning, Kjeller). Jan 1972. 19p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on meteorological data and assuming cases of ground release and stack disposal, the relative concentrations of radioactive gaseous effluents at various prospective nuclear power plant sites in the Oslofjord district are calculated. The expectation value of such releases is also calculated, and the results presented in graphical and tabular form. (NO)

27340 (NVO-130) POST MORTEM FINDINGS IN SOME MARINE MAMMALS AND BIRDS FOLLOWING THE CANNIKIN TEST ON AMCHITKA ISLAND. Rausch, R. L. (Arctic Health Research Center, Fairbanks, Alaska (USA)). Jul 1973. 86p. Dep. NTIS $5.45.

Animals fatally injured by effects of the Cannikin detonation on Amchitka Island were subjected to post mortem examination, and representative tissues were studied microscopically. From evidence so obtained, in combination with other information, it was concluded that three mechanisms were involved in producing the range of lesions observed: rock-falls; vertical acceleration; and combined effects of over- and underpressures. Two sea otters, Enhydra lutris (Linnaeus), on the beach at the time of the detonation, were crushed by falling rocks. Eight birds (seven harlequin ducks, Histrionicus histrionicus (Linnaeus), and a pelagic cormorant, Phalacrocorax pelagicus Pallas) also sustained crushing injuries, evidently when exposed rocks upon which they were resting were violently displaced upward by vertical acceleration. Animals that were diving at the time of the detonation were exposed to a pressure-pulse followed by a fall in pressure to cavitation and a subsequent rise to the pre-existing ambient. In ten sea otters and in four harbor seals, Phoca vitulina (Linnaeus), lesions produced respectively by overpressure and underpressure were distinguished, although some of the disruptive changes in the lungs could not be specifically related to one of these factors. Fatal injuries in seven birds, representing six species, were attributed to effects of pressure-changes. In two sea otters, traumatic lesions of undetermined origin were superimposed upon those produced by pressure-changes. Because of the scarcity of injured but still living mammals, it appears that the rate of mortality was high among those that were diving in the critical areas at the time of the detonation, but those at the surface probably were uninjured. (auth)

27341 (NVO-746-13) ALEUTIAN SEISMIC PROGRAM HYPOCENTER SUMMARY, OCTOBER 1972–APRIL 1973. (Geological Survey, Las Vegas, Nev. (USA)). Jun 1973. Contract AT(29-2)-746. 54p. Dep. NTIS $4.75.

Preliminary data acquired from an Aleutian network of seismograph stations are presented. These computations are preliminary and may be revised on the basis of current research. The Aleutian hypocenter summary is a listing of all earthquakes located with a network of seismograph stations operated by the Branch of Seismic Engineering in the western Aleutian Islands. The summary lists the date, time, geographic coordinates, and depth of each event. (CH)

27342 (TID-26444) SOIL BEHAVIOR UNDER EARTHQUAKE LOADING CONDITIONS. State of the Art Evaluation of Soil Characteristics for Seismic Response Analyses. (Shannon and Wilson, Inc., Seattle, Wash: Agbabian Jacobsen Associates, Los Angeles, Calif.). Jan 1972. Subcontract 3354. 395p. Dep. NTIS $21.75.

For Oak Ridge National Lab., TN.

In designing nuclear reactor facilities special consideration must be given to earthquake effects. A study is presented that includes consideration of the problems of establishing the design earthquake for nuclear power plant facilities; review of site investigation procedures; listing of methods used to determine the dynamic properties of soils; a summary of data available on dynamic properties of soil; and consideration of liquefaction of soil and soil subsidence. (DHM)

27343 WATER QUALITY CONSIDERATIONS: SITING AND OPERATING OF NUCLEAR POWER PLANTS. Conference held at Washington, D. C.: 1–4 October 1972. New York; Atomic Industrial Forum, Inc. (1972). vp. (CONF-7210105-).

Separate abstracts were prepared for the 17 papers appearing in these proceedings. (ERB)

For abstracts of individual papers see: 27208, 27228, 27346, 27365–27368, 27374, 29238–29245, and 29255.

27344 LEGAL ASPECTS OF ENVIRONMENTALISM. Krieger, J. H. J. Amer. Water Works Ass.; 65: No. 8, 532-537(Aug 1973).

Implications of the National Environmental Policy Act of 1969 (NEPA) are discussed. The effects of the legislation on the trans-Alaska oil pipeline and the licensing of nuclear power plants are pointed to in particular. The need for the water-utility industry to understand and face the issues squarely is emphasized. (JGB)

27345 GEOHYDROLOGY OF THE EASTERN PART OF PAHUTE MESA, NEVADA TEST SITE, NYE COUNTY, NEVADA. Blankennagel, R. K.; Weir, J. E. Jr. U. S., Geol. Surv., Prof. Pap.; No. 712-B, B1-B35(1973).

A deep structural depression, the Silent Canyon caldera, underlies the eastern part of Pahute Mesa, Nye County, Nev. The caldera is elliptical in plan and measures about 11 by 14 miles; the greater axis trends in a north-northeast direction. Exploratory drilling revealed a tertiary volcanic section of ash-flow and ash-fall tuffs and rhyolitic lava flows which attained thicknesses in excess of 13,686 feet. Hydraulic tests made in deep drill holes indicated that these volcanic rocks are capable of transmitting water and that measurable permeability occurs at depths greater than 3,500 feet below the top of the saturated zone. Most movement of ground water beneath the mesa occurs through interconnecting fault and joint systems. In the Silent Canyon caldera, depth to water ranges from about 1,952 feet (alt 4,164 ft) in the western part to 2,350 feet (alt 4,685 ft) in the eastern part. In the extreme northwestern part of the Nevada Test Site, outside the caldera, the depth to water is about 850 feet (alt 4,700 ft). Pumping tests indicate that transmissivities range from 1,400 to 140,000 gallons per day per foot. The greatest transmissivities occur in holes drilled along the east margin of the caldera, where the principal rock type in the saturated zone is rhyolite. Ground water beneath Pahute Mesa moves southwestward and southward toward the Amargosa Desert through Oasis Valley, Crater Flat, and western Jackass Flats. The flow, across a 15-mile underflow strip which extends from the hydraulic barrier on the west to the ground-water divide on the east, is estimated to be 8,000 acre-feet per year. Owing to the difficulty in obtaining accurate porosity data, estimates of ground-water velocity vary as much as two orders of magnitude, 5 to 250 feet per year. Based on the assumption that most ground-water movement occurs along interconnected fractures and that some movement occurs through interstices, a reasonable estimate of velocity is less than 15 feet per year. (auth)

27346 NUCLEAR PLANT SITING ON ESTUARIES: A REVIEW. Mihursky, J. A. (Univ. of Maryland, College Park). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

From a world wide and long term aquatic ecosystem viewpoint, it seems quite clear that steam electric station (S.E.S.) siting with once-pass cooling should avoid estuarine sites unless an environmentally neutral technology can be developed. It is also clear, however, that in the near term, estuarine sites will be used for once-pass heat-exchange systems. Under these latter conditions, distinct strategies can be employed to minimize S.E.S. damage to this environment if regional and site-specific environmental flexibilities and vulnerabilities are sorted out, and an effort is made to employ engineering know-how to design and operate accordingly. (auth)

Thermal Effluents

Refer also to abstracts 27230, 27291, 29235, 29240, 29241, and 29243–29245.

27347 (ANL-7960(Pt. 3), pp 69-70) GREAT LAKES THERMAL STUDIES: THERMAL EFFECTS FROM THE POINT BEACH NUCLEAR POWER PLANT. Spigarelli, S. A. 1972.

In Radiological and Environmental Research Division annual report, January–December 1972.

During 1971 extensive biological sampling was conducted in Lake Michigan in an attempt to quantify any demonstrable effects of thermal effluent discharge from the Point Beach Nuclear Power Plant. Sampling and analyses of benthos, plankton, and periphyton failed to detect any effects on biomass or primary production beyond the measurable thermal plume limits. Significant increases in periphyton production were observed at sampling stations near the thermal discharge. The most obvious effect observed was the attraction and apparent concentration of various species of fish at the thermal discharge during certain seasons of the year. Methods used for tagging fish for determination of migration patterns in Lake Michigan are described. The rate of change of body temperature and fish behavior relative to water temperature were tested for five species of fish: carp (Cyprinius carpio), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), chub (Coregonus sp.), and alewife (Alosa pseudoharengus). Results of measurements of body temperature responses of these five species showed that the heat exchange half-time differed between species and sizes of test fish. (CH)

27348 (CONF-710501-P1, pp 18-29) THERMAL POLLUTION: MYTH OR REALITY. Parker, F. L.; Benedict, B. A.; Polk, E. M. Jr. (Vanderbilt Univ., Nashville). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Though relatively few fish kills due to thermal pollution have occurred so far, the projected increase in the use of electrical power in the modes and locations presently envisioned indicates that offstream cooling will be required to prevent damage to the fishery resources. It is shown that it is a social or political decision that balances the cost of the cooling facilities against the costs of the damages done, since damages cannot be completely determined. Further work is required to quantify these relationships. Beneficial uses of waste heat may help defray the costs of control of thermal pollution. There is still much to be learned about the effects of cooling towers on the climate. (MCG)

27349 (CONF-710501-P1, pp 513-523) RESPONSE OF FISH POPULATIONS IN THE WABASH RIVER TO HEATED EFFLUENTS. Gammon, J. R. (DePauw Univ., Greencastle, IN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The distribution of fish in two segments of the Wabash River, one receiving thermal inputs, was determined during 1967 to 1970 using hoop nets and electrofishing apparatus. Differences in species composition were found that seemed to result from the different thermal conditions. At the site of an 860-MW generating station three thermal zones were delineated: (1) a thermally unmodified zone above the station, (2) an effluent area that was elevated 7 to 8 C, and (3) a thermally mixed zone below the plant elevated 2 to 4 C during the summer and fall. Catch data converted into relative density indices and plotted against mean temperatures revealed ranges of thermal preference for 19 species of fish. A sharply defined maximum thermal preferendum was usually found. Younger, smaller individuals of most species had higher maximum preferenda than older, larger individuals. Flathead catfish (Pylodictis olivaris) and possibly channel catfish (Ictalurus punctatus) increased their population density below the plant through improved reproductive success. Populations of golden and shorthead redhorse (Moxostoma erythrurum and M. breviceps) were affected deleteriously by the thermal inputs. (auth)

27350 (CONF-710501-P1, pp 524-527) ABUNDANCE AND LOCAL MOVEMENT OF LARGEMOUTH BASS (MICROPTERUS SALMOIDES) IN A RESERVOIR RECEIVING HEATED EFFLUENT FROM A REACTOR. Gibbons, J. W.; Bennett, D. H. (Savannah River Ecology Lab., Aiken, SC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Ecological studies of the largemouth bass (Micropterus salmoides) were conducted on Par Pond, a South Carolina reservoir receiving heated water from a nuclear reactor. Population density of bass is greater in the heated areas of the lake, particularly during the winter. Individual bass exhibit a high mobility in the reservoir, with movement of more than 6 km being of frequent occurrence. The majority of individuals recaptured in the heated areas appear to have remained in the same place. (auth)

27351 (CONF-710501-P1, pp 537-544) THERMAL EFFECTS ON SURVIVAL AND PREDATION FOR SOME PUGET SOUND FISHES. Stober, Q. J.; Mayer, D. L.; Salo, E. O. (Univ. of Washington, Seattle). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Thermal tolerance tests were conducted on juvenile pink salmon (Oncorhynchus gorbuscha) and chinook (O. tshawytscha), surf smelt (Hypomesus pretiosus), juvenile English sole (Parophrys vetulus), and adult Dungeness crab (Cancer magister) in a marine laboratory constructed at a proposed nuclear power site in Northern Puget Sound, Washington. Geometric mean times to equilibrium loss and death were calculated for upper lethal temperatures ranging from 24 to 29°C for pink salmon, 24 to 30°C for chinook salmon, 21 to 25°C for surf smelt, 25 to 28°C for English sole, and 25 to 30°C for Dungeness crab. The linear regression model was found to give the best fit for all species. Pink salmon were much less tolerant and showed equilibrium loss earlier than chinook. Ambient water temperatures, salinities, and dissolved oxygen concentrations are given for tests on each species. Thermal effects on predation were conducted on a group of pink and chum (O. keta) salmon at 10 (ambient), 15, 17.5, 20, 22.5, and 25°C for stress periods of 10, 30, 60, 100, 960, and 1440 min. Chinook salmon were tested at 10 (ambient), 15, 20, 22.5, 23, and 25°C for stress periods of 10, 100, and 1440 min. Chi-square analysis and instantaneous mortality rates (dp ratios) suggested thermal effects on rates of predation only above 20°C. (auth)

27352 (CONF-710501-P1, pp 545-554) EFFECT OF TEMPERATURE, SALINITY, AND FOOD AVAILABILITY ON GROWTH AND ENERGY UTILIZATION OF JUVENILE SUMMER FLOUNDER, PARALICHTHYS DENTATUS. Peters, D. S.; Angelovic, J. W. (National Marine Fisheries Service, Beaufort, NC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Growth rates and growth-related processes were measured under various combinations of temperature, salinity, and food availability. Growth of 0-age class fish were measured as increase in live weight, dry weight, and caloric content. Growth efficiency, assimilation efficiency, and oxygen consumption rates were also measured. The data were summarized by regression equations analyzed by analysis of variance and graphically presented as response surface diagrams. Growth rates were fastest at high temperatures and rapid feeding rates even though greatest efficiency was near $^2/_3$ ad libitum feeding and from 20 to 25°C. Growth rates predicted from assimilation and respiration rates did not correspond with measured growth. (auth)

27353 (CONF-710501-P1, pp 564-568) GROWTH OF THE COLUMBIA RIVER LIMPET, FISHEROLA NUTTALLI (HALDEMAN), IN NORMAL AND REACTOR-WARMED WATER. Coutant, C. C.; Becker, C. D. (Pacific Northwest Labs., Richland, WA). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Limpet snails (Fisherola nuttalli) were collected through 1969 to 1970 at locations above and below thermal additions from reactor discharges in the central Columbia River above Richland, Washington. Temperatures of the mixed river water below the reactor operations were increased about 0.5 to 2.5°C. Limpet sizes and growth rates at any collecting period did not differ significantly between the two areas. Growth of young limpets was most rapid from July to October when Columbia River temperatures were high. Growth rates stabilized during the fall and winter when temperatures dropped and became minimum, then increased with warming temperatures of early spring. Adult limpets collected from downstream areas and held in the warmed water in the laboratory reproduced successfully. Deposition of egg cases by mature limpets occurred on rising temperatures in April, May, and June during the period of maximum river flows. High mortality occurred among mature limpets during and following the reproductive period. The Columbia River limpet, like many other gastropod molluscs, has a predominantly one-year life cycle. (auth)

27354 (CONF-710501-P1, pp 569-573) QUANTIFICATION OF THE EFFECTS OF RATE OF TEMPERATURE CHANGE ON THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS). Speak-

man, J. N. (Corps of Engineers, Ft. Belvoir, VA); Krenkel, P. A. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

As the number and capacity of nuclear power generating facilities increases, resulting in more concentrated loads of waste heat being discharged into the environment, the regulation of heated water discharges must be based on more rational and complete stream temperature standards. One factor generally omitted from many state stream standards concerns the rate at which environmental temperatures may fluctuate without causing irreparable damage to the aquatic biota. Based on an extensive review of the literature concerning the primary parameters affecting the response of fishes to temperature stress, a laboratory procedure for examining the acute effects of rate of temperature change similar to the routine bioassay method of examining the toxicity of chemical pollutants has been developed, and the applicability of the method has been tested through an investigation of the lethal rates of temperature change for the hearty bluegill sunfish (Lepomis macrochirus). The results of the investigation demonstrate the lethality of temperature fluctuations within the recognized range of adaptibility of the bluegill. It is concluded that less tolerant species might be severely stressed by temperature fluctuations of less magnitude and lower rate of change. (auth)

27355 (CONF-710501-P1, pp 574-578) EFFECTS OF SUBLETHAL THERMAL SHOCK ON THE BLOOD SERUM PROTEINS OF THE RAINBOW TROUT (SALMO GAIRDNERI). Guderley, H.; Ulrikson, G. (Oak Ridge National Lab., TN). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Electrophoretic patterns of the blood serum proteins of fish subjected to sublethal temperature stress were examined for initial and postshock effect. Fingerling rainbow trout (Salmo gairdneri) were acclimated to 16°C for two weeks, divided into four groups, and then shocked for 5 min in 30, 28, 26, or 16°C water. Some fish were examined immediately after stress, while the remaining were returned to 16°C water for varying lengths of recovery time. Results showed an initial decrease and leveling off of the albumins, an initial increase over the final levels of the total alphas, and a strong response in the alpha-1 globulins. Results are discussed in view of their physiological significance and thermoacclimatory mechanisms. (auth)

27356 (CONF-710501-P1, pp 603-618) CHEMICAL AND HYDROLOGICAL INVESTIGATIONS IN THE VICINITY OF A THERMAL DISCHARGE INTO A TROPICAL MARINE ESTUARY. Gerchakov, S. M.; Segar, D. A.; Stearns, R. D. (Univ. of Miami, FL). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

Chemical and hydrological investigations were conducted in the area of thermal discharge adjacent to the Florida Power and Light Turkey Point Generating Plant in lower Biscayne Bay, Florida. The salinity, temperature, oxygen content, nitrate, nitrite, silicate, phosphate, iron, and copper concentrations and the alkalinity of the water in this area were studied during a two-year period. Major changes in the chemical parameters monitored were not apparent as a result of the power plant operation. However, certain small changes were observed that may contribute to or be caused by biological changes in the discharge area. Profiles of the bottom sediment temperatures were found to closely correlate with average thermal plume observed in the overlying water. (auth)

27357 (CONF-710501-P1, pp 619-629) EFFECTS OF POWER PLANT OPERATION ON HUDSON RIVER ESTUARY MICROBIOTA. Haffner, R. L.; Howells, G. P.; Lauer, G. J.; Hirshfield, H. I. (New York Univ., NY). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Field observations and results of laboratory studies undertaken to assess the effects of entrainment through the condensers of a nuclear power station at Indian Point on bacteria, phytoplankton, and zooplankton are reported. The Indian Point station is located on the east bank of the Hudson River Estuary (mile 43). The results obtained to date indicate that effects on organisms in laboratory experiments vary with intensity and duration of exposure. Studies of phytoplankton and zooplankton in the estuary during a three-year period failed to show discernible effects on gross population abundance. The studies are continuing. (auth)

27358 (CONF-710501-P1, pp 630-638) EVALUATION OF ENVIRONMENTAL EFFECTS OF THE OSWEGO STEAM STATION ON LAKE ONTARIO. Skelly, M. J.; Lawler, J. P. (Quirk, Lawler and Matusky Engineers, Tappan, NY). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The engineering and ecological investigations undertaken in Lake Ontario in connection with the proposed thermal discharge from unit 5 of the Oswego Steam Station are summarized. A mathematical model was employed to determine preliminary discharge designs that would ensure 11-fold dilution of the thermal discharge prior to reaching the lake's surface. Hydraulic model tests for various designs, locations, current, and temperature were used to determine the final design and location for the intake-discharge system. It was found that six 2-ft-diam double-port nozzles on 40-ft centers, 5 ft above the lake bed in 26 ft of water, assured adequate jet dilution and should not adversely affect the ecology of the area. The ecological surveys conducted in Lake Ontario and the Oswego Harbor area are also summarized. The results of these investigations indicated that the thermal discharge from the existing station is not adversely affecting the ecosystem in Oswego Harbor. In addition, the new discharge is not expected to significantly affect the biota in Lake Ontario. (auth)

27359 (CONF-710501-P1, pp 645-651) TEMPERATURE EFFECTS ON PHYTOPLANKTON PRODUCTIVITY IN A REACTOR COOLING POND. Marshall, J. S.; Tilly, L. J. (Savannah River Lab., Aiken, SC). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Temperature effects on primary productivity were measured by the ^{14}C method at Par Pond Savannah River Plant, Aiken, South Carolina, by suspending samples of plankton secured at a "cool" station at that station and at a station warmed by reactor effluent. Light-saturated photosynthetic rates for each run at each station were compared statistically. Mann Whitney "U" results for experiments conducted during the months of December through May showed 15 stimulations, 7 insignificant differences, and 5 inhibitions of primary productivity by warm station incubation. In contrast, during the months of June through August, there were 5 inhibitions, 5 insignificant differences, and 3 stimulations. Incubator studies run concurrently with field experiments revealed temperature optima for photosynthesis that do not exhibit pronounced seasonal variations. Optima were 5 to 15°C above habitat temperature during October through April and within 3°C during May through August. A weak but highly significant correlation ($r = 0.756$; $P = <0.001$) was found between the optimum temperature for primary production and habitat temperature. (auth)

27360 (CONF-710501-P1, pp 660-668) EFFECT OF TEMPERATURE ON RESPIRATION AND FISSION IN BLEPHARISMA INTERMEDIUM. Kasturi Bai, A. R.; Srihari, K. (Bangalore Univ., India). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

In an earlier investigation it was observed that in Blepharisma intermedium the reproductive rate increased from 24°C, the initial temperature, to an optimum at 28°C, whereafter the rate declined to zero at 38°C. A common way of measuring an organism's "efficiency" is to measure its oxygen consumption, often as a function of some environmental variable. This paper records the oxygen consumption of B. intermedium at different temperatures, using Winkler's iodometric method for the estimation of dissolved oxygen content. The respiratory rate of Blepharisma increased initially with the rise in temperature up to an optimum, and then with further rise in temperature there was a steady decline in the rate of oxygen consumption. In B. intermedium the optimum temperature is the same for oxygen consumption as well as cell division. At 28°C, maximum division was observed, but with a progressive rise in temperature there was a corresponding decline in fission rate. A change in hydrogen ion concentration of the medium was observed with a change in temperature and oxygen consumption. However, the chloride content was not affected. A study of succinic dehydrogenase activity at different temperatures was also recorded. These studies prove that a rise in environmental temperature exposes the aquatic organisms to two stresses – reduction in the dissolved oxygen of the water and change in the pH. Changes in these two factors cause changes in the diverse types of aquatic life and disturb the normal environment. (auth)

27361 (CONF-710501-P1, pp 669-678) LIMITS OF TEMPERATURE TOLERANCE AND HYDROGEN ION CONCENTRATION OF

A FEW PROTOZOANS. Kasturi Bai, A. R.; Tara, S. V.; Dilli, L. (Bangalore Univ., India) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Temperature and hydrogen ion concentration are two major factors that affect the life, growth, and reproduction of aquatic organisms. Commonly the following freshwater ciliates—Spirostomum ambiguum major and minor, Blepharisma intermedium, B. seshachari, Frontonia, and Stentor—occur together, along with other organisms, in waters with a pH near neutral and a temperature range of 15 to 32°C during the different seasons. These ciliates can be cultured in the laboratory in hay infusion fortified with Horlicks malt. The present paper reports the lethal, optimum, and maximum temperature tolerance of these ciliates after acclimating them to different temperatures above 22°C and counting their number every third day for a period of 20 days. Similarly, a study of the interacting effects of pH in the alkaline and acid range and different warm temperatures was made. Changes in the activity, morphology, and reproductive rate of the ciliates with changes in temperature were recorded. Population density at the intraspecific, interspecific, and community level was determined. Results of the present study as a measure for the evaluation of the effects of water pollution on biological material is discussed. (auth)

27362 (HEDL-TME-73-45) THERMAL EFFECTS OF PROJECTED POWER GROWTH: THE NATIONAL OUTLOOK. Peterson, D. E.; Bailey, G. F.; Engstrom, S. L.; Schrotke, P. M. (Hanford Engineering Development Lab., Richland, Wash.). Jul 1973. Contract AT(45-1)-2170. 128p. Dep. NTIS $5.45.

Direct cooling capacities of streams in eight major drainage areas in the United States (North Atlantic, South Atlantic-Eastern Gulf Coast, Ohio, Upper Mississippi, Lower Mississippi, Missouri, Columbia-Snake, Pacific) are summarized for average and low-flow conditions. Topical reports have previously been issued for each of the major drainage areas under study. Total capacity, considering not only direct heating of the rivers, but also their ability to dissipate heat to the atmosphere, ranged upward from a ten-year monthly low of 560 GW_T (gigawatts thermal). This value is reduced to a useable capacity of 260 GW_T when projected generation patterns for 1990 are considered. The remaining cooling capacity is in excess of local requirements or its distribution does not facilitate development in this time span. (auth)

27363 (SRO-701-1) STUDY OF SELECTED COOLING POND DESIGN TECHNIQUES. Final Report. Gibbons, J. H.; Pike, F. P. (South Carolina Univ., Columbia. Coll. of Engineering). Jun 1973. Contract AT(38-1)-701. 76p. Dep. NTIS $5.45.

Visits were made to six electric utilities in the Southeast, exploring their information needs in regard to cooling reservoirs and their thermal rejection problems in general. In addition, visits were made to the Edison Electric Institute and to two consulting firms, Dames and Moore and the Alden Research Laboratory. The primary need of utilities with respect to cooling reservoirs is for quick ways to approximate the answers, in order to decide what questions and tasks to refer to consultants. Major related engineering problems with respect to cooling reservoirs are how to interpret the regulations and how to plan for the monitoring. It is clear from the literature that no generally accepted design procedures for cooling ponds are yet available. The key problem is the degree of mixing, which can be measured only with great difficulty. If the lake is completely mixed, or the flow through it is plug flow, design procedures are available. These two solutions bracket the case of the real reservoir, which is partially mixed. The available literature is reviewed, and the importance of the mixing problem is stressed. References are listed on (a) various models for the behavior of cooling ponds, (b) stratified flow of heated discharges and (c) stratification in lakes. It is possible with a heat-conduction model to successfully model existing reservoirs for which sufficient data are available. For the use of utilities, a rule of thumb is available to estimate the size of cooling ponds. Other quick answers are provided by the nomographs of Throne and of Langhaar. Beyond that, one could consult a group such as the one at Johns Hopkins University or Alden Research Laboratory. The Savannah River calculational model of Neill and Babcock has been reviewed in the context of other available solutions. An appropriate abridgement is presented here. (auth)

27364 WASTE HEAT FROM THERMAL POWER PLANTS CAN GIVE POSSIBILITIES FOR PROFITABLE AQUACULTURE. Devik, O. (Institutt for Vitenskap og Aandsfrihet, Bergen). Tek. Ukebl.; 120: No. 33, 5-10(9 Aug 1973). (In Norwegian).

While the release of waste heat to the Rhine will lead to water temperature problem it is not expected that similar problems should occur in Norwegian coastal regions. On the other hand it may be profitable to utilize the accelerated growth of plants, fish, and shellfish, due to the marginally higher water temperature, commercially by aquaculture. In addition to heat, fertilizer and fodder may be supplied. Net booms preventing fish from leaving and keeping undesired fish out and feed systems are already in use. Economic analyses show that a 2 to 4°C increase in water temperature improve the profitability of salmon and oyster production by factors of approximately 2 and 1.5 respectively. Lobsters, flounders, and eel are also of interest. (NO)

27365 DEVELOPING AN ADEQUATE HYDROTHERMAL MONITORING PROGRAM. Brodfeld, B. (Stone and Webster Engineering Corp., Boston). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

As a result of stringent regulatory requirements controlling thermal discharges from power plants, hydrothermal monitoring programs have become essential activities. In addition to being presently required by Federal and State regulations to demonstrate compliance with temperature criteria, such programs play an important role in the selection of the best suited engineering concepts for thermal discharges as well as in the development and validation of mathematical models for temperature predictions. For these reasons, hydrothermal monitoring must now be recognized as an important engineering tool as an activity that should be carefully coordinated with the licensing effort, biological studies, and engineering activities on a power plant project. The various phases of hydrothermal monitoring in the overall picture of a nuclear power plant project are discussed, the impact of regulatory requirements on monitoring programs is reviewed, and the application of available monitoring techniques is illustrated. (auth)

27366 GUIDELINES FOR DEVELOPING STUDIES TO DETERMINE THE BIOLOGICAL EFFECTS OF THERMAL DISCHARGES. Cairns, J. Jr.; Dickson, K. L. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

A program to provide scientifically sound data on the effects of a heated discharge on the aquatic community should be designed to show whether or not the following requirements are being met at that particular site: heated waste-water discharges should not detrimentally alter the productivity characteristic of that particular locale; temperatures should not exceed either the maximum or minimum tolerances for indigenous organisms; fish and other aquatic organisms should not be acclimated to temperatures so high that they would die from low temperature stress if the plant were to cease functioning in midwinter; temperature variations should not preclude specific seasonal activities such as production and maturation of reproductive materials, produce aberrant behavior, or in other ways upset seasonal cycles; temperatures should permit the maintenance of the species diversity characteristic of that particular locale; and temperatures should not impede the downstream drift of insects, the migration of fishes, or other activities of this type. (ERB)

27367 HEATED EFFLUENT DISPERSION IN RIVER AND ESTUARIES: STATE-OF-THE-ART OF ANALYTICAL MODELING. Cearlock, D. B.; Baca, R. G.; Jaske, R. T. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1831. pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Many mathematical predictive methods are available for application to heated effluent dispersion problems. A review of these models indicates a tremendous diversity in their scope and purpose, their mathematical detail, system elements being modeled, size of system that can be handled, data input requirements and computer output. This diversity is a result of the different applications involved and the advancement of modeling techniques. The more simplified methods, such as closed form solutions and empirical relationships, have been classically used since means were not available for using more realistic methods. In general, the systems being modeled are too complex (especially

coastal, estuarial or tidally influenced waters) for simplified methods to produce the accurate predictions presently being required for environmental assessments. (auth)

27368 PREDICTING RESPONSES OF AQUATIC BIOTA TO THERMAL STIMULI. Raines, G. E.; Bloom, S. G.; Levin, A. A. (Battelle Columbus Labs., OH). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The simulations developed in this study demonstrate that it is possible to mathematically model aquatic environments to account not only for purely physical phenomena, such as heat or physical mass transfer, but also the actions and interactions of the biota. It is the response of the biota to these physical phenomena that is of primary interest in any aquatic environment, rather than the physical phenomena themselves. This response is the result of both the direct effects of the physical phenomena, such as direct mortality, decreased or increased reproduction, and increased growth rate, and the indirect effects such as mortality to predators or prey and changes in migration patterns. The example demonstrates one way to include all these effects in a mathematical model. A frequent argument against the feasibility of utilizing ecological models is that insufficient data exist to formulate a mathematical model. However, the examples discussed were developed from very limited data. However, it should be recognized that the degree of confidence in the results of a simulation developed from limited data may not be high. However, such a simulation can be used to identify the major factors affecting the response of the biota and, in this way, guide the data acquisition toward those areas needing further study. As the data on those areas needing further study become available, they can be used in a more comprehensive model, and the degree of confidence in the simulation results will increase. For prediction purposes, it is necessary to identify only the important groups of species and their major predators and prey. It is not necessary to identify all species in the environment. Once these major groups have been identified, their biomass should be determined and the biomass transfer between species or groups of species should be measured. An outline of this type of data acquisition is given. With this type of data, an adequate simulation model for aquatic environments can be developed and the results of the simulation can be used to predict the response of aquatic biota to the addition of waste heat. (auth)

27369 DIELDRIN. Effects of Chronic Sublethal Exposure on Adaptation to Thermal Stress in Freshwater Fish. Silbergeld, E. K. (Stroud Water Research Center, Avondale, PA). Environ. Sci. Technol.; 7: No. 9, 846-849(Sep 1973).

The freshwater fish, Etheostoma nigrum, were pretreated with 2.3 ppB dieldrin for 30 days and then exposed to thermal stress, applied by heating the water at a rate of 1°C/hr to a maximum of 7–9°C above ambient temperature. Pretreated fish had significantly higher mortality than fish not pretreated with dieldrin but also exposed to the same thermal stress. Measurements of blood glucose, feeding, growth, oxygen consumption, opercular movement, whole body lipid content, and liver condition were made throughout the experiment. Pretreated fish demonstrated significant changes in all of the above parameters except opercular movement during the first 15 days of exposure to dieldrin. After 15 days, pretreated fish were found to have adapted to dieldrin exposure, as indicated by significant reversals of the above changes (except for liver damage, which was not reversed but progressed over time). In the adapted state, the pretreated fish remained different from untreated fish, in terms of these parameters. These differences provide grounds for predicting differential response to sublethal thermal stress for the pretreated and untreated fish. Such response is discussed as it may relate to the effects of chronic sublethal exposure to dieldrin. (auth)

27370 COMPARISON OF OCCURRENCE AND ABUNDANCE OF FISHES WITHIN THREE TEXAS RESERVOIRS WHICH RECEIVE HEATED DISCHARGES. Hodson, R. G. College Station, TX; Texas A and M Univ. (1973). 459p. University Microfilms Order No. 73-21,669.

Thesis (Ph. D.).

Occurrence and abundance of fishes were studied in heated and non-heated areas of Lake Bastrop, Lake Nasworthy, and North Lake reservoirs used for cooling by power plants. Measurements of temperature, dissolved oxygen content, pH, and conductivity were taken. Among reservoirs there was an inverse relationship between maximum megawatt load per surface hectare of reservoir and abundance of fish, but differences in fertility and species composition were thought to explain better than heat most differences among reservoirs. Lake Bastrop was essentially a bass-sunfish pond; Lake Nasworthy was just past its peak years of production and contained large populations of several species; and North Lake maintained low stable fish populations dominated by rough fishes. Large gizzard shad utilized the shallow parts of the reservoirs (discharge areas included) during late winter and early spring to spawn. At Lake Nasworthy this occurred approximately a month earlier in the heated than in the non-heated area. Subadult and adult gizzard shad concentrated in the heated area of Lake Nasworthy during the latter part of each year. Significantly more gizzard shad, 101 to 209 mm long, were trawled in the heated area of Lake Nasworthy than in the non-heated area. Some threadfin shad were taken in Lake Bastrop and North Lake and there were no significant differences between heated vs. non-heated areas. Sexually ripe carp migrated up the discharge canals as if they were inflowing streams. During their spawning season, "new" water flowing into a reservoir may attract river carpsucker more than discharge current. Smallmouth buffalo appeared evenly distributed in North Lake, except they were not taken at the head of the discharge canal. Black bullhead utilized shallow heated and non-heated areas of the reservoirs during winter and spring, but attraction to current apparently accounted for their greater abundance in the discharge canals. Small channel catfish moved into the discharge canal at Lake Nasworthy during late spring and summer, but moved out when water temperatures approached 35°C. Large channel catfish were more abundant in the heated than in the non-heated area and peak catches occurred during the summer even when water temperatures were above 35°C. There was no significant difference between catches of white bass in heated vs. non-heated areas of Lake Nasworthy where most were taken. Seasonal movement of warmouth was not evident. In Lake Bastrop there was no significant difference between the number of warmouth in heated vs. non-heated areas, but at Lake Nasworthy significantly more warmouth were taken in the non-heated than in the heated area. Generally, they were not taken in the discharge canals. Orange-spotted sunfish, abundant only in Lake Nasworthy, were more abundant in the non-heated than in the heated area. Catches at a heated station, lacking noticeable current, were similar to those at non-heated stations. The most pronounced seasonal pattern for bluegill, longear, and redear sunfishes was movement into deep water during cold months and to shallow water during warm months, regardless of whether it was a heated or non-heated area. Some longear sunfish appeared to migrate up the discharge canal at Lake Nasworthy during the winter. Significantly more white crappie were trawled in the non-heated than in the heated area of Lake Nasworthy, but there was no significant difference between areas for gill-netted fish. Cold kill of native freshwater fishes following shutdown of a Texas power plant appears unlikely because they make little winter use of heated effluents. (Diss. Abstr.)

Chemical Effluents

Refer also to abstracts 26954, 27235, 27236, 27687, 29245, and 29508.

27371 (AECL-4439) STUDY OF WORKERS EXPOSED TO AN ORGANIC COOLANT. Hawkins, R. J.; Weeks, J. L. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jun 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

The study of workers exposed to organic coolant vapour in a nuclear research reactor has been described in an earlier paper. The present report relates to the continuation of this study. For the coolant being used, 40% hydrogenated terphenyl, an MPC of 0.5 $mg.m^{-3}$ has been proposed. During the five years of the study, measured air levels have ranged from 0.07 $mg.m^{-3}$ in general working areas of the reactor to 0.89 $mg.m^{-3}$ in areas which are only occasionally entered. At these levels, no ill effects have been noted in the exposed population. (auth)

27372 (COO-1407-49) RAIN SCAVENGING STUDIES. Progress Report No. 9. Dingle, A. N. Jul 1973. Contract AT(11-1)-1407. 123p. Dep. NTIS $8.25.

Meteorological factors that influence the transport and deposition of NaI particles following release for cloud modification in the vicinity of frontal storms in central Illinois are discussed in relation to rain scavenging. Rainwater samples collected over a large area were analyzed to determine the amounts and rates of Pb deposition by rain. A mathematical model of contaminant scavening by precipitation is presented and the parameters introduced into this model are evaluated in accordance with well known physical processes that take into account particle and droplet size spectra. The performance of an air sampler is discussed in relation to the formation and growth of $(NH_4)_2SO_4$ crystals during use. (CH)

27373 (KFK-1804-UF) APPLICATION OF THE POLLUTER-PAYS-PRINCIPLE IN THE FIELD OF WATER MANAGEMENT. Proceedings of the 2nd International Expert Discussion, Karlsruhe, November 20–21, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 260p. (In several languages). (CONF-721150-).

This publication contains the proceedings of the international expert discussion on the application of the polluter-pays-principle in the field of water quality management, held on November 20–21, 1972 at the Nuclear Research Center, Karlsruhe, Germany. First, the four invited papers which formed the basis of the discussions are presented. The first one (by Battelle, Frankfurt) investigates to what extent the competing conditions for some selected products are changed by effluent charges. Furthermore, a cost-benefit analysis for the pollution abatement in the Sieg river basin is attempted. In the second paper, J. P. Barde (OECD, Paris) discusses how the polluter-pays-principle is put into practice in Finland, France, and the Netherlands. The paper presented by W. Haefele (Nuclear Research Center, Karlsruhe) analyses the pollution problem in its totality and discusses the steps necessary to solve it. The main subject of this paper is the Environment Survey, which means the systematic measurement of the state of the environment and of its alterations caused by productive and consumptive activities. Some concrete contributions to this Environment Survey are presented. The fourth invited paper by W. Kruse (Ministry of Economics, Fed. Rep. of Germany) is a case study dealing with the waste oil disposal in the Federal Republic of Germany. At the end of the conference the results of the discussions were summarized into eight theses. These are given verbatim and commented by the organizers. In an appendix those contributions to the discussion which were available in written form are given. (GE)

27374 PROBLEMS AND POTENTIAL SOLUTIONS TO BIOLOGICAL ENTRAINMENT AND CHEMICAL DISCHARGES. Lauer, G. J.; Waller, W. T.; Beck, A. P. (New York Univ. Medical Center). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Entrainment through cooling systems of power plants may cause damage to the organisms involved. The major concern is that such damage to entrained organisms might result in damage to their populations, their food chain relationships, and to energy transport through the food web to desired species in the receiving water. The effects of temperature changes, pressure changes, and chemical additives on entrained microbes, plankton, and fish are discussed. (ERB)

27375 MERCURY BALANCE ON A LARGE PULVERIZED COAL-FIRED FURNACE. Billings, C. E. (Environmental Engineering Science, Chestnut Hill, MA); Sacco, A. M.; Matson, W. R.; Griffin, R. M.; Coniglio, W. R.; Harley, R. A. J. Air Pollut. Contr. Ass.; 23: No. 9, 773-777 (Sep 1973).

Results of a survey are presented of mercury concentrations in coal, ash, water, fly ash, and flue gas discharges from a 5.5×10^6 lb/hr steam generator serving a 775 MW (net) turbine-generator set. Representative composite or grab samples were obtained for inlet coal and outlet ash and water. Stack samples were obtained for fly ash and mercury vapor emissions while the unit was operated at 660 MW (net) (85% of full load). Samples were analyzed by anodic stripping voltammetry, plasma emission spectroscopy, and neutron activation analysis to determine mercury concentration entering the furnace in the coal and leaving the furnace in the flue gas, fly ash, bottom and hopper ash, and water. Method intercomparisons are discussed. A material balance for mercury was calculated from fuel, ash, and stack gas flow rates. About 90% of the mercury in the coal is released and appears as vapor discharged in the stack gas while 10% remains in the residual ash. For a 700 MW (net) unit, about 5 lb/day of mercury vapor is released to the atmosphere. (auth)

27376 CHEMICAL ANALYSIS OF THE ENVIRONMENT AND OTHER MODERN TECHNIQUES. Ahuja, S.; Cohen, E. M.; Kneip, T. J.; Lambert, J. L.; Zweig, G. (eds.). Progress in Analytical Chemistry. Volume 5. New York; Plenum Publishing Corporation (1973). 394p.

Separate abstracts were prepared for four of the 23 papers appearing in this publication. The other papers discuss atmospheric trace metal studies, pesticide analysis in the environment, the determination of anions in water, pharmaceutical analysis, and methods of automated analysis. (ERB)

For abstracts of individual papers see: 26954, 27321, 27667, and 27668.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 27015, 27584, 27585, 28786, 29080, and 29253.

27377 (AD-760147) PROTON–ALPHA PARTICLE DETECTOR FOR USE IN SATELLITES. Final Report, 12 November 1970–28 February 1973. Hanser, F. A.; Sellers, B.; Morel, P. R. (Panametrics, Inc., Waltham, Mass.). Feb 1973. Contract F19628-71-C-0109. 91p. (AFCRL-TR-73-144). NTIS.

A satellite-borne detector for protons and alpha particles has been developed and flown. The detector uses two totally depleted silicon surface barrier detectors in a coincidence telescope arrangement to detect 5 to 100 MeV protons and 20 to 100 MeV alpha particles. A calibration mode allows the front detector to be used to detect 1 to 5 MeV protons and 10 to 30 MeV alpha particles. A detailed theoretical treatment of the telescope operation, including the rejection capability for electron detection, and a description of the electronics is presented. Results from a telescope orbiting in satellite OV5-6 are presented. Calibration mode data from quiet times show the system electronic gains to be substantially the same as before launch while data from outer trapped electron belt show the telescope to be highly immune to electron counting. (auth)

27378 (AD-762208) DESIGN, FABRICATION, AND FLIGHT OF A HEAVY PARTICLE IDENTIFICATION INSTRUMENT FOR SATELLITES. Final Report, February 1969–December 1972. Sellers, B.; Hanser, F. A.; Morel, P. R. (Panametrics, Inc., Waltham, Mass.). May 1973. Contract F19628-69-C-0234. 52p. (AFCRL-TR-73-216). NTIS.

A particle identification instrument for measurement of protons, deuterons, tritons, ^{3}He and ^{4}He has been designed and fabricated, and it was launched on Air Force satellite S72-1 in October 1972. The instrument is basically a telescope arrangement that makes use of four silicon detectors with a plastic anticoincidence shield. Proton spectra are determined within the range 4 to 45 MeV, and alpha spectra between 18 and 70 MeV, with intermediate energy ranges for the other particles. Design, calibration and high quality flight results are reported, and recommendations are made for certain instrumental modifications based on these results. (auth)

27379 (BARC/I-213) DEVELOPMENT AND STANDARDIZATION OF MAY PACK FOR THE CHARACTERIZATION OF RADIOIODINE AEROSOLS. Jauhri, G. S.; Krishnamony, S.; Chudalayandi, K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 29p. INIS.

A sampling device, popularly known as May Pack, has been developed and standardized to differentiate among the various species of airborne radioiodine. The device is an extremely useful tool for investigating the behavior of radioiodine aerosols and in the performance evaluation of the different iodine clean-up systems now in use or being proposed. The May Pack used in the present study consists of a number of filter media held together in a three piece metallic cylinder with nozzles on both the ends for in-line connection to any sampling line. Each filter medium selectively removes one component from the mixture of the different iodine species. The device is calibrated using laboratory samples of radioiodine as (1) molecular iodine, (2) methyl iodide, (3) hydroiodic acid, and (4) particulate iodine. Because of the affinity of iodine towards silver, silver coated copper screens have been used. The May Pack has been utilized to obtain information regarding the various forms of iodine that may be present in the iodine processing cell of the Isotopes Processing Plant as well as the forms that may be released to environment through the stack. The distribution of iodine in process cell air as well as in the stack effluents on May Pack components is shown. In order to detect particulate activity in the stack effluent which mainly consists of ionic and organic iodides, a combination of charcoal impregnated filter papers and a KI impregnated charcoal absorber is used. It has been established by gamma spectrometry of each sample that no nuclide other than ^{131}I is present in the environment and in the effluents. (INIS)

27380 (BNWL-1751(Pt. 2), pp 89-92) RADIATION INSTRUMENTATION: IN VIVO PLUTONIUM MEASUREMENTS. Swinth, K. L. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Studies on intraesophageal probes including avalanche diode probes and fiber-optic couple scintillators; laboratory intercalibration of sources in plutonium whole body counters; and plutonium localization techniques are briefly discussed. (WHK)

27381 (DESY-73/22) CALCULATION OF THE CURRENT OF AN IONIZATION CHAMBER IN A PULSED ELECTROMAGNETIC FIELD AND COMPARISON WITH MEASUREMENTS: APPLICATION TO RADIATION MONITORING AT ELECTRON STORAGE RING. Dinter, H.; Tesch, K. (Deutsches Elektronen Synchrotron, Hamburg (West Germany)). Jun 1973. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

The charge concentration in an ionization chamber exposed to an electromagnetic field is calculated up to moderately high dose rates. From this the ionization current is derived for continuous radiation fields, for pulsed radiation fields with low and high repetition rates as well as for one single radiation pulse. The calculations were verified with an argon filled chamber for pressures between 1 and 50 atmospheres, average dose rates up to 10 rad/h and repetition rates between 1 and 50 Hz (duty cycles between 2×10^{-6} and 1×10^{-4}). Without using a free parameter an agreement better than 20% on the average is achieved. The suitability of the chamber for the radiation survey at the storage ring DORIS is discussed. (auth)

27382 (FRNC-TH-396) RESPONSE OF SURFACE BARRIER DETECTORS TO HEAVY IONS AND ENERGY LOSSES OF INTERMEDIATE MASS IONS IN MATTER. Borderie, B. (Paris Univ., Orsay (France)). 1973. 65p. (In French). Dep. NTIS (U. S. Sales Only) $5.25.

Thesis.

The energy responses of 3 different surface barrier detectors were studied for the following ions: ^{40}Ar, ^{63}Cu, ^{65}Cu, ^{107}Ag, ^{109}Ag, ^{141}Pr and ^{197}Au. The measurements led to the determination of the ionization defects at the origin for each ion. These results are compared with other experimental results obtained using a different technique. It is deduced that the ionization defect increases with the atomic or mass number of the ion detected and that for ions lighter than Mg, there are no longer ionization defects, these properties being deduced for nuclei possessing a Z/A ratio lying within the β stability region. In the case of Ar, the ionization defect is almost independent of energy. A simple representation demonstrated the effect of the ion energy on the ionization defect. In this way, it was possible to completely determine the ionization defect above 40 MeV. In addition, the stopping power was studied for ^{40}Ar and ^{141}Pr in the following slowing-down materials: ^{27}Al, ^{63}Cu, ^{65}Cu, and ^{197}Au. The energy ranges for the two ions studied were in the 2 MeV/amu and 0.4 MeV/amu regions respectively. The results are compared with predictions made by Steward, and Northcliffe and Schilling. (FR)

27383 (IAE-2078) NEUTRONS SPATIAL MICRODISTRIBUTION MEASUREMENT BY FISSION FRAGMENT TRACKS DENSITY DISTRIBUTION IN POLYETHYLENETEREPHTHALATE. Gulimov, V. N.; Zarubin, Yu. V.; Obukhov, V. K.; Ushakov, Yu. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 8p. (In Russian). INIS.

A method for the measurement of the three-dimension microdistribution of neutrons by means of flexible sandwiches composed of polyethyleneterephthalate films and U-containing targets is described. Examples of the method are reported and the possibilities of the method are characterized. Recommendations on the application of the method are given. (tr-auth)

27384 (LBL-2092) LIQUID XENON FILLED WIRE CHAMBERS FOR MEDICAL IMAGING APPLICATIONS. Derenzo, S. E.; Budinger, T. F.; Smits, R. G.; Zaklad, H.; Alvarez, L. W. (California Univ., Berkeley. Lawrence Berkeley Lab). May 1973. Contract W-7405-eng-48. 16p. (CONF-730541-3). Dep. NTIS $3.00.

From symposium on advanced technology arising from particle physics research; Argonne, Illinois, USA (17 May 1973).

In 1968, Luis Alvarez suggested that a high-resolution multiwire particle detector could be developed using a thin layer of liquified noble gas as the detection medium. After key problems in chamber construction, purification, and readout had been solved, a spatial resolution of 15 μ rms was demonstrated. Work is in progress to build high-resolution chambers and measure their properties for particle physics experiments at high-energy accelerators. The liquid xenon multiwire chamber also has potential in nuclear medicine for imaging isotope distributions with an unprecedented combination of gamma-ray detection efficiency and spatial resolution. A preliminary 24-wire chamber has been constructed; this chamber

detects 280-keV gamma rays with 65% efficiency and 4-mm FWHM spatial resolution. Initial images of point and distributed sources are very promising, and the liquid purity can be maintained for periods exceeding several days. (auth)

27385 (ORNL-TM-4045) ORSS-72: A COMPUTER-BASED, DUAL-DATA RECTILINEAR SCANNING SYSTEM. Bell, P. R.; McClain, W. J.; Ross, D. A.; McKeighen, R. E.; East, J. K.; Moore, E. C.; Edwards, C. L.; Goswitz, F. A. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 203p. Dep. NTIS $12.25.

An improved version of the ORNL computer-based scanning system with complete data reduction and imaging programs is described. The system is primarily software controlled, requiring simple interfaces between the imaging system and computer and between the computer and display scope. This improved version of the scanning system permits the access of data from two channels, with counts originating either from a dual-head scanner or from windows set at different energies accepting data from a single-head scanner. Access of data can be accomplished in either an End-of-Line or a Reference-Line format. During data access, a comment mode permits the entry of specific comment data, identifying the scan in progress and specifying the conditions of the patient and scan. These comments become a part of the data file, and they are displayed with the data at all times. The commands in the data-handling mode have been expanded to permit the combination of two full data files (addition or subtraction) with selected scaling of one; entry into a third command mode permits the entry, deletion, and revision of comments, the calling of overlay routines for any function desired by the user, and the processing of data. The processing routines include bounding, smoothing, validation, and the antiscatter correction program that corrects for scatter of gamma photons within the patient as well as for collimator septum penetration of photons originating from areas not in the optical field of view of the detector. The processing functions have been speeded up by use of special features in the software multiply routine. Provisions for a more complete library of process weighting arrays have been facilitated by a more efficient method of handling these weights in the processor routine. A multicycle contrast enhancement (MCCE) display mode has been added. This display permits a quantitative interpretation of all levels of the image. Provisions have also been added to permit interaction with the computer system monitor. A number of patient image examples show the effects of operations of the processing programs. An appendix contains the listing of the operating system as well as lists of overlay routines to be used in certain applications of the program. (auth)

27386 (STU-70-385-U-316) DEVELOPMENT OF LITHIUM COMPENSATED GERMANIUM DETECTORS. Lauber, A.; Rosencrantz, B. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1971. 13p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

Coaxial Ge(Li) detectors with very large (60 to 100 cm^3) compensated volumes have been developed. The work was based on an earlier developed method for the manufacture of medium-sized (20 to 35 cm^3) coaxial Ge(Li) detectors. The mechanical and thermal fragility of the very large germanium ingots used and the depth of the compensated layer (15 to 20 mm) made further developments necessary. In order to avoid cracking, the lithium diffusion process had to be remade; in order to obtain good energy resolution a new and more efficient instrumentation for clean-up drift had to be developed. As a result of this work very large coaxial detectors with excellent energy resolution can now be manufactured in a reproducible way. There remain some unsolved problems however, the most important being to ensure depletion of the entire compensated volume. With compensated layers 15 to 20 mm deep the working bias voltages used at present (of the order of 2000 V) are unsatisfactory. (auth)

27387 IONIZATION CHAMBER. Iakunine, M. I. Russian Patent 284,815. 16 Dec 1968. (In Russian).

A spectrometric ionization chamber is described which is composed of a water- and air-tight body with a cathode on which is placed the source of ionizing radiation, one anode, auxiliary electrodes, anode shields, and correction fields. To increase the energy resolution and the precision of the measurements the cathode is flat, the anode cylindrical and the auxiliary electrodes in the working region are in close proximity in the form of noncoaxial cylindrical surfaces coinciding with the surfaces of equal potential between cathode and anode. (TSS)

27388 SCINTILLATOR FOR NEUTRON RECORDING. Tcherniaiev, V. B.; Sokolova, Z. Ya. (to Ordena Lenina Fiziko Techni Checkii). Russian Patent 248,851. 16 Nov 1967. (In Russian).

A scintillator is described for recording neutrons based on zinc sulfide, boric acid containing boron-10 at a rate of more than 80%, potassium chloride for melting up to 8%, silver nitrate at a rate of 10^{-4} Ag/1g ZnS. To increase the efficiency of recording of neutrons and to increase the light yield, boric acid is used in a ratio of 18 to 24%. (TSS)

27389 SCINTILLATOR FOR NEUTRON RECORDING. Sokolova, E. J. (to Fiziki Technitcheskii Institut). Russian Patent 216,856. 15 Feb 1967. (In Russian).

A scintillator for neutron recording based on a mixture of ZnS(Ag) with H_3BO_3 and a blending material is described. To increase the efficiency of registration of the neutrons and reduce the background noise resulting from the radioactivity itself as a blending material the scintillator contains a lithium-6 compound. (TSS)

27390 LITHIUM-DRIFTED SILICON $\Delta E/\Delta x$ DETECTORS WITH AN 8 CM^2 SURFACE. Guseva, V. I.; Zhits, M. M.; Popov, N. V.; Sokol, G. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 139-141(1972). (In Russian).

In order to increase the area of Si detectors a slit was made in the ingot along the growth axis. Employment of common technology in the preparation of surface-barrier drift detectors yielded $\Delta E/\Delta x$ detectors with an area of 8 cm^2, a thickness of 600 μ, with a resolution for 5-MeV α-particles of 150 keV. These detectors were intended for spectrometry and identification of deuterons and π^+-mesons with energies of from 10 to 200 MeV. This same technology makes possible Si detectors with an area of up to 20 cm^2, which could in turn be used in mosaic structures for attaining 100 cm^2 or more. (tr-auth)

27391 DETERMINATION OF ANGULAR DISTRIBUTION DURING SCATTERING OF FAST NEUTRONS (APPROX. 14 MeV) WITH PHOTOEMULSIONS. Belovitskii, G. E.; Kolesnikova, L. N.; Sukhov, L. V.; Romanova, T. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 123-129(1972). (In Russian).

The neutron background under different conditions was determined as a prelude to employing the photoemulsion method to study scattering of ~14-MeV neutrons. On the basis of the background data a service was designed to measure the angular distributions of neutrons in the range 45 to 140°. This device could be used to measure the differential cross sections up to 4 mbarn/ster for a ratio of background/effect $\leq$ 1. (tr-auth)

27392 Ge(Li) DETECTOR RESPONSE TO AN Am-Be NEUTRON SOURCE. Shani, G. (Univ. of the Negev, Beersheba, Israel). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 519-524(Sep 1973).

The effect of fast and thermal neutrons from an Am-Be neutron source on a Ge(Li) detector has been studied. Three different measurements were carried out. First, the detector was exposed to a 1-Ci Am-Be neutron source, then a 7-cm-thick paraffin slab was placed between the source and the detector, and third, the detector was wrapped with 1-mm cadmium sheet. Measurements were performed in a low energy and a high energy range. The part of the spectrum between 3 and 4.5 MeV was found to be completely screened by the 4.43-MeV γ-ray from ^{12}C in the source. In both energy regions two types of γ-rays from different origins were detected: capture γ-rays from the germanium and γ-rays emitted by the source. The latter were found to be very intense in the low-energy range. The capture-γ-ray spectrum in germanium has been compared with other results. (auth)

27393 CRYOSTAT FOR NUCLEAR RADIATION DETECTORS. Govorov, A. M. (to Objedinennyi Institut Iaderykh Issledovanii). Russian Patent 280,692. 28 Jan 1969. (In Russian).

A cryostat is described for nuclear radiation detectors that consist of a vacuum jacket with a cooling tube and a sorbent in which, in order to conserve the absorbing power of the sorbent and maintain a strong vacuum during a long period, the cryostat contains an insulation permitting the vacuum separation of the sorbent of the detection portion of the cryostat from the other part. The coolant tube is equipped with a screw and is connected with the jacket by a pump while between the coolant product and the vacuum jacket of the cryostat is installed an adjustable thermal bridge in the form of two cylinders arranged with a thin wall fixed between them with openings for exhaustion (pumping out). (TSS)

27394 MINIATURE DETECTOR APPARATUS FOR NUCLEAR RADIATIONS PROVIDING LUMINOUS AND ACOUSTIC SIGNALS. Lefevre, C. (to La Radiotechnique Compelec). French Patent 2,146,103. 16 Jul 1971. 9p. (In French).

A radiation detector is presented, which can be worn by the user like a film badge, and which provides an immediate warming when the level of radioactivity increases dangerously. The apparatus consists of an electric cell, a Geiger-Mueller tube, a transistor oscillator working in conjunction with a transformer provided with primary and secondary windings, and a gas discharge indicator tube. The device operates with a single cell which is

permanently charged by a small number of photovoltaic elements. The double warning system (luminous and sound) utilizes functional elements of the device without consuming supplementary energy. In the absence of direct radioactive radiation, the permanent control of the functioning of the apparatus is ensured by the detection of cosmic radiation having an average frequency of several counts per minute. (FR)

27395 SAMPLE CHANGER WITH A GERMANIUM DETECTOR FOR MEASURING THE ACTIVATION OF NEUTRON FLUENCE PROBES WITH WIDELY VARYING ACTIVITIES. Meixner, C.; Weise, L. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 15: No. 7, 314-318(1973). (In German and English).

An automatic measuring station with a germanium semiconductor detector was developed for routine determinations of high thermal and fast neutron fluences involving large numbers of activation probes. The high energy resolution of the detector ensures a very good discrimination against disturbing effects and thus makes it possible to measure the activity of irradiated probes despite contaminations of the gamma spectrum. The specified wide measuring range of more than 4 orders of magnitude is achieved by varying the distance between the semiconductor detector and the sample and by intercalating lead absorbers in the beam path. This facility, used at present exclusively for neutron fluence determinations by the probe activation method, can of course, also be used for other routine measurements of gamma-active samples within the same activity range. (GE)

27396 GAMMA-QUANTUM RECORDING OF HUMAN RADIATION BY SPECTROMETERS. Moiseev, I. F.; Fedorov, G. A.; Bamblevskii, V. P. (Moscow-Engineering Physics Inst.). Med. Radiol.; 18: No. 8, 42-47(Aug 1973). (In Russian).

Mathematical substantiation of the possibility of obtaining recording efficiency independence on nuclide localization in the phantom is given. Calculations made on the computer and experimental data showed that by proper processing of the results of measurements or by modifying the time of measuring by each of 8 NaI (Tl) detectors with dimensions of 140 × 100 mm arranged in a line over the surface of the phantom and by using a geometric mean of the two measurements, it is possible to provide high uniformity of computing with the point source travelling along the axis of the elliptic phantom and along its cross section. (auth)

27397 SOLID STATE RADIATION DETECTOR. Hagood, J. W.; Shelton, J. (to United States Atomic Energy Commission). U. S. Patent 3,749,915. 31 Jul 1973. Filed date 11 Apr 1972. 4p.

A solid state radiation detector for charged particles which does not require high voltage components is described. A charged particle collecting plate is connected to the gate of a field effect transistor which is followed by a dc amplifier and an indicator. The circuit uses a floating gate on the field effect transistor to provide improved sensitivity. The detector may be used to detect non-charged particles by placing an appropriate target forward of the collecting plate. (Official Gazette)

27398 METHOD OF MEASURING FAST-NEUTRON FLUX. Smith, D. L. (to United States Atomic Energy Commission). U. S. Patent 3,748,472. 24 Jul 1973. Filed date 11 Aug 1972. 12p.

This invention consists of a novel method for measuring the neutron flux of monoenergetic fast-neutrons in the 700 to 5,000 keV energy range. A shielded, planar lithium-drifted germanium detector is placed so as to view a fast-neutron source. A collimated beam of 700 to 5,000 keV monoenergetic fast-neutrons from the neutron source is impinged upon the Ge(Li) diode of the detector. The number of internal conversion electrons with an energy of 691 keV produced within the Ge(Li) diode due to neutron inelastic scattering are counted and then converted according to a predetermined efficiency ratio for the detector into a value for neutron flux, the number of internal conversion electrons emitted being proportional to the total number of neutrons incident on the detector. (Official Gazette)

27399 BIFILAR HELICAL MULTIWIRE PROPORTIONAL CHAMBER. Thiessen, H. A.; Sobottka, S.; Lee, D. M. (to United States Atomic Energy Commission). U. S. Patent 3,743,840. 3 Jul 1973. Filed date 18 Jul 1972. 4p.

A helical multiwire proportional chamber for detection of minimum ionizing particles consisting of an array of anode wires surrounded by a cathode wound in the form of a bifilar flattened helix nearly orthogonal to the anode wires is described. This chamber has an active area rectangular in shape, a frame comprising two pieces of plexiglass with a central cutout which forms the said active area, the anode wires being fastened to one of the frame pieces and the second frame piece being fastened to the first and the anode wires being connected in parallel to a positive high voltage supply and the cathode wire being connected to ground through a resistor. (Official Gazette)

27400 STATISTICS OF ELECTRON COUNTING. Every, I. M. (Monash Univ., Clayton, Australia). J. Phys., A (London); 6: No. 9, 1375-1382(Sep 1973).

The probability $P(n,t_1,t_2)$ of counting n electrons in the time interval from t_1 to t_2 is derived from a quantum-electrodynamic treatment of an electron multiplier. Although the expressions obtained are similar to those obtained by Glauber for photons there remain fundamental differences. The interest of these results for existing and proposed experiments on electron beams is outlined. (auth)

27401 RADIOMETRIC MEASUREMENT OF THE HALF-LIFE OF CESIUM-137. Corbett, J. A. (Westinghouse Electric Corp., Madison, PA). Nucl. Eng. Int.; 18: No. 208, 715-716(Sep 1973).

The half-life of ^{137}Cs was measured using a Harshaw "Integral Line" unit consisting of a sodium iodide detector coupled to a DuMont phototube. The measured value of 30.44 ± 0.5 y fell within the range of previous radiometric measurements and was slightly higher than the best estimate value of 30.0 ± 0.5. The long term reliability of the detector was high. (UK)

27402 CONTINUOUS LIQUID-SCINTILLATION FLOW MEASUREMENTS. Verhassel, J. P. Messtechnik; 81: No. 2, 53-57 (1973). (In German).

The various methods for continuous measurements of labeled compounds in fluid or gaseous effluents are described, especially regarding initial developments, homogeneous fluid flow measurements, and characteristics of a modern cell for fluid flow and scintillators. (GE)

27403 PROBLEMS ENCOUNTERED IN THE DETECTION OF TRITIUM: SOLUTIONS PROPOSED. Cluchet, J. (CEA, Paris). Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 81-90(Apr 1973). (In French).

The various processes used in the detection of tritium are examined in a critical manner from the point of view of radioprotection (detection using ionization chambers, proportional counters, and scintillation techniques). The various practical devices are presented. With the exception of measurements of tritium or tritiated water vapor using ionization chambers or certain proportional counters, all the processes used require a sampling phase followed by a physical or chemical preparation. The sensitivity of a method must, therefore, take into account the yields of the different phases. The examination of the performances of the various equipment together with economic considerations revealed that ionization chambers were the most suitable devices for such measurements. (FR)

27404 OPTIMIZATION OF THE GEOMETRIC FACTORS OF THE TELESCOPE DESIGNED FOR THE REGISTRATION OF CHARGED PARTICLES IN OUTER SPACE. Kolchin, A. A.; Lebedev, V. V.; Pyatkin, A. S.; Skrebtsov, G. P. Kosm. Issled.; 11: No. 3, 465-469(1973). (In Russian).

A method was described for the calculation of the geometric factors of the two-component telescope, the aperture of which is set with a collimator. Formulas were derived for the calculation of the geometric factors of the three-component telescope. The magnitudes of the geometric factors were calculated on the EVM for different values of the telescope parameters and the results were reported in the forms of graphs which can be used for the optimization of the parameters of the telescope designed for the measurement under conditions of isotopic emission. (tr-auth)

27405 APPARATUS AND METHOD FOR MEASURING THE INTENSITY OF A BEAM OF NEUTRAL ATOMS OR MOLECULES. Simms, D. L.; Tolk, N. H.; White, C. W. (to Bell Telephone Labs., Inc.). US Patent 3,757,114. 4 Sep 1973. Filed date 8 Mar 1972. 6p.

The intensity of a beam of neutral particles traveling at velocities of up to 3.4×10^7 cm/s may be monitored by inserting a precalibrated target in the path of the beam, and measuring the intensity of photon emissions which result from collision of the particles with the target. The intensity of the beam is related to the intensity of the photon emissions by the calibration factor of the target material. The intervention may be used, for example, in conjunction with neutral particle implantation techniques. (Official Gazette)

27406 CONTRIBUTION TO THE LIQUID-SCINTILLATION COUNTING OF FILTER MATERIALS. Buchtela, K.; Tschurlovits, M. (Oesterreichischen Hochschulen, Vienna). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 531-533(Sep 1973). (In German).

Radioactive samples on optical transparent foils are counted with high efficiency (95% ^{204}Tl) by liquid scintillation. These

transparent foils are obtained by moistening porous materials with solvents of suitable refractive indices. This technique is of interest for measuring radioactive chromatograms, electropherograms and aerosol filters. Several types of filter material have been investigated. (auth)

27407 LARGE NEUTRON COUNTERS FOR SUPERMONITORS. Blokh, Ya. L.; Dorman, L. I.; Koiyava, V. K.; Leopov, V. Kh.; Narziev, Kh.; Chaikovskii, V. G. Kosm. Luchi; No. 13, 181-182 (1972). (In Russian).

Large neutron counters of the SNM-15 type designed for the neutron supermonitor with an area of about 20 m^2 are described. Statical accuracy of the counters is 0.1% per 2 hours. Dimensions: length—2 m; diameter—150 mm; pressure—200 mm Hg. The counters are filled with BF_3 gas containing over 80% of ^{10}B. (auth)

27408 DISCHARGE—CONDENSATION METHOD FOR DETECTING THE TRACES OF CHARGED PARTICLES. Mandzhavidze, Z. Sh.; Roinishvili, V. N. Kosm. Luchi; No. 13, 187-189 (1972). (In Russian).

A new discharge–condensation method is suggested for detecting the tracks of charged particles. The chamber designed on the basis of this method possesses a high time resolution (several microsecs) and a greater memory time (dozens of millisecs). Photographed traces of cosmic particles in the discharge–condensation chamber are given. (auth)

27409 INSTRUMENTS OF NUCLEAR MEDICINE. I. Anger, H. O. (Univ. of California, Berkeley). Hosp. Pract.; 7: No. 6, 45-54(Jun 1972).

The light flash, or scintillation, that occurs in a sensitive material when its electrons are excited by incoming radiation can be detected, multiplied, translated into electrical pulses, selected for energy values, and recorded—thereby providing an image of the distribution of radioactivity in the organ or tissue into which a tracer has been introduced. The techniques by which this goal is reached are detailed. (auth)

27410 GAS COUNTING OF TRITIUM. Schell, W. R. (Univ. of Washington, Seattle). pp 113-126 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Information on techniques of tritium measurement by gas counting are reviewed and methods are discussed for simplifying calibration and standardization problems. (DHM)

27411 REVIEW OF TRITIUM MONITORING DEVICES. Kelley, H. L.; Phillips, C. R. (Eastern Environmental Radiation Lab., Montgomery, AL). pp 133-143 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A review of tritium monitoring devices is presented that includes consideration of constant readout monitors; the ionization chamber; the proportional counter; the scintillator-PM tube; and tritium collection systems. (DHM)

27412 MEASURING TRITIUM WITH LIQUID SCINTILLATOR SYSTEMS. Horrocks, D. L. (Argonne National Lab., IL). pp 143-156 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The use of liquid scintillation counting for measurement of tritium is reviewed with respect to solvents and solutes; techniques for including tritiated water into liquid scintillator solutions; counting techniques for measuring tritium-containing samples; and methods for measuring sample quenching effect upon counting efficiency in liquid scintillator solutions. (DHM)

27413 PRACTICAL LIMITS OF TRITIUM DETERMINATION IN A SCINTILLATION COUNTER. Laney, B. H. (Nuclear Chicago Corp., Des Plaines, IL). pp 156-170 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A modern liquid scintillation counter may be expected to reproduce a tritium assay within ± 2% at one sigma over a wide range of quench and sample volume, heterogeneous and color quenched samples excluded. Reproducibility of ±0.5% is possible at efficiencies greater than 20% using the SCR method of quench correction. However, total counting time of low activity samples may be longer than with the external standard. Sample vials are the major source of background uncertainty: glass ±1.0 cpm, polyethylene and nylon ±0.3 cpm. Prior determination of vial background or statistical averaging can reduce the uncertainty in background. Excess background due to phosphorescence and chemiluminescence is detectable by at least three methods: double ratio, double dpm, and photon monitor. The latter method automatically takes corrective action by delaying or rejecting an errant sample. Temperature stabilization is recommended when background stability better than ±0.5 cpm is required. Higher figure of merit, E^2/B, is obtained by setting the upper discriminator to a lower value in the presence of high environmental radioactivity. (auth)

27414 CONTINUOUS MONITORING OF AQUEOUS TRITIUM ACTIVITY. Ting, P.; Litle, R. L. (Beckman Instruments, Inc., Fullerton, CA). pp 170-183 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A simple, continuous flow cell system is described and performance evaluated for a weak β-emitter (tritium). Efficiency of the system is high. Contamination (or memory) is low. Less than four cell volumes are required for complete clean-up. Another common problem, light piping, was also eliminated. With the specially designed mixing chamber, the system is capable of detecting as low as 60 pCi/ml. The serum-cap sample port provides the capability of individual injection. This is convenient and useful if the LS counter is set up for continuous monitoring, but single sample measurements are required occasionally. The flow cell probe can be inserted into all Beckman Liquid Scintillation System counting wells. No mechanical and electronic modifications are necessary. A standard teletypewriter, paper tape, or a recorder with one hundred millivolt full scale range can be used as the read-out system. (auth)

27415 APPLICATION OF EMULSIONS IN TRITIUM COUNTING WITH REFRIGERATED SYSTEMS. Lieberman, R. (Environmental Protection Agency, Montgomery, AL); Benjamin, P.; Prewitt, B. P.; Orth, R. pp 183-186 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

An investigation was made in an effort to find an emulsifier system that would incorporate 40% water and remain clear at temperatures below 10°C. The emulsifiers evaluated were Triton X-100, Triton N-101, and Triton-45. The effect of the secondary fluor, p-bis(o-methylstyryl)benzene on the counting efficiency of 13% Triton N-101–4% Triton X-45–43% toluene–40% water system was also studied. The primary fluor was diphenyloxazole. (DHM)

27416 NEW PROCEDURES FOR LIQUID SCINTILLATION COUNTING OF TRITIUM USING MULTI-SIZE POLYESTER PLASTIC FILM TUBES. Gupta, G. N. (Rockefeller Univ., New York). pp 186-191 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Ultra-micro, micro, semi-micro, and standard liquid scintillation counting through the use of multi-size polyester plastic film tubes is reported. The polyester plastic film used for the tubes is transparent, impermeable, and has excellent resistance to moisture and most organic solvents. It is far superior to polyethylene vials in its physical and chemical properties. (DHM)

27417 CORRELATION BETWEEN SAMPLE ADSORPTION AND PULSE HEIGHT SHIFT IN LIQUID SCINTILLATION COUNTING. Wigfield, D. C.; Srinivasan, V. (Carleton Univ., Ottawa). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 613-614(Oct 1973).

In liquid scintillation counting of certain organic compounds there exists the serious problem of sample adsorption to the surface of the counting vial, giving rise to false counting data as a result of changed counting geometry. It is reported that the pulse height shift caused by the backscattering energy loss is readily measurable by a simple channels ratio method, thus providing a nondestructive method of detecting such adsorption. (UK)

27418 MEASURING DEVICE FOR RADIOACTIVE TEST BARS. Schulz, J.; Gottschald, J.; Ostertag, H. (to Telefunken Patentverwaltungs GmbH). German Patent 1,614,798. 23 Dec 1970. Filed date 5 Apr 1967. (In German).

The test bars are placed in a plane above and below which is located a radiation detector surrounded by a screen. This screen which is located between the detector and the plane of the samples has a differentiating effect of a type such that the residual radia-

tion from an experiment crossing the screen and falling on the detector is of the same magnitude regardless of the position the sample is in the sample plane. (TSS)

27419 PREDICTED AND MEASURED PERFORMANCE OF A SEGMENTED-CHANNEL FOCUSING COLLIMATOR. Neill, G. D. S. (Eastern Regional Hospital Board, Dundee, Scotland). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 563-570(Oct 1973).

Equations are derived for the geometrical focal-plane point-spread functions of focused multichannel collimators with rectangular channels arranged in a non-rectangular array. These point-spread functions and the corresponding modulation transfer functions are shown to be very similar to those of a conventional circular-channel collimator with the same base-hole area, the differences being negligible when square holes are used. Prediction of the rectangular-channel response in non-focal planes is not attempted. The construction of a thin-septa segmented channel collimator is described, using a method which gives very accurate channel alignment. The line-spread functions of the collimator at various distances are measured at 145 keV and 27 keV. Close agreement is obtained between the measured performance and that predicted for a circular-channel collimator with the same channel axes and the same base-hole area. (auth)

27420 NONHOMOGENEITY IN THE BASIC REGION OF Si(Li) p-i-n DETECTORS OF NUCLEAR RADIATION. Azimov, S. A.; Muminov, R. A.; Yafasov, A. Ya. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 14-16(1972). (In Russian).

The structure of Si(Li) p-i-n nuclear radiation detectors was calculated from the model of Subashiev and Tuchkevich (1947). Si(Li) p-i-n detectors were fabricated from dislocation-free p-Si (the density of dislocations <100/cm^2) with given parameters, and used to derive a relationship and family of curves for ReZ as a function of ω ImZ. It was concluded that the S & T model could be used to investigate transitions and structures of diodes while subjecting them to destruction. (KSW)

27421 STUDY OF THE SIMULTANEOUS MEASUREMENT OF ^{3}H AND ^{14}C BY MEANS OF A GAS-PROPORTIONAL COUNTER. Miyatani, D.; Takeuchi, T. (Toyama Univ., Japan). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 553-562(Oct 1973).

The simultaneous measurement of ^{3}H and ^{14}C was studied by means of a gas-proportional counter using a mixture of tritium and ^{14}C-carbon dioxide. Two types of counter tubes of different diameter sizes and two kinds of filling gas, methane and butane, were used. It was found that the similarity in the energy spectra held for ^{14}C, but did not hold for ^{3}H. It was advantageous for the distinction between the energy spectrum of ^{3}H and that of ^{14}C that the maximum range of the β particle of ^{3}H was shorter than the diameter of the counter tube. The amounts of ^{3}H and that of ^{14}C in the mixed gas can be determined within an error of 5% when methane is used as the filling gas and within 3% when butane is used. (auth)

27422 METHODS AND APPARATUS FOR MONITORING SIMULTANEOUSLY TWO ENERGY LEVELS OF RADIOACTIVITY IN A GAS. Gant, P. L.; Motes, B. G.; Brundage, R. S. (to Continental Oil Co.). US Patent 3,746,861. 17 Jul 1973. Filed date 23 Dec 1970. 10p.

A method and apparatus for detecting, distinguishing, and indicating low-level activity of radioactive gases, such as tritium and/or krypton-85, in a selected gas, even in the presence of electronegative gases are described. The apparatus consists of a detection chamber of a type which is energy selective through inclusion of plural ionization collector circuits providing two separate detector outputs. The two detector outputs are applied then to parallel signal processing channels which serve to separate detected energy through pulse amplitude discrimination and/or coincidence selection to determine absolute quantities of radioactive events for selected contaminants in the gas sample. (Official Gazette)

27423 NEW METHOD FOR PARTICLE IDENTIFICATION ON LIGHT NUCLEAR CHARGED PARTICLES BY MEANS OF A SOLID-STATE TRACK DETECTOR. Murakami, A. (Saga Univ., Japan). Nucl. Instrum. Methods; 111: No. 3, 567-571(1973).

A new method is presented for particle identification and energy measurement on light nuclear charged particles by means of a solid-state track detector. The principle and the concrete method of particle identification are given with theoretical calculations. This method is applicable in the energy region from about 0.5 MeV per nucleon up to about critical energy for the particles with the atomic number $z \lesssim 20$. (auth)

27424 MECHANISM OF SECONDARY ELECTRON MULTIPLICATION WITHIN A CURVED CHANNEL MULTIPLIER. Loubet, D.; Barat, C. (Univ., Toulouse). Nucl. Instrum. Methods; 111: No. 3, 441-444(1973).

An analytical study of secondary electron (S.E.) trajectories and a simulation of electron cascades were made for the C-shaped channel electron multiplier (C.E.M.), neglecting saturation phenomena in the tube. The results permit an interpretation of the gain variation as a function of the potential gradient. In particular, the quasi-gaussian pulse height distribution can be explained by electron multiplication characteristics without space charge or field distortion contributions. (auth)

27425 ARRAY DETECTOR FOR THE SPECTROSCOPIC STUDY OF REACTIONS PRODUCING ^{8}Be AND ^{8}Be*. Cramer, J. G.; Eberhard, K. A.; Fletcher, N. R.; Mathiak, E.; Rossner, H. H.; Weidinger, A. (Univ., Munich). Nucl. Instrum. Methods; 111: No. 3, 425-430(1973).

A multi-detector counter for detecting ^{8}Be particles in ground and excited states is described. The counter consists of seven rectangular Si(Li) detectors 8.9 mm by 22.6 mm, closely positioned, so that the central angles of the detectors are 5° apart plus an eighth detector placed at a non-adjacent position. The breakup cone of the ^{8}Be $\rightarrow \alpha + \alpha$ reaction is normally such that the ^{8}Be ground state is detected only by one of the six pairs of adjacent detectors, while reactions leading to the excited state at 2.9 MeV or at 11.4 MeV are detected in most of the 28 pairs of detectors. Techniques for the separation of events and the reduction of data are discussed. (auth)

27426 PEAK SHIFTS IN GAS PROPORTIONAL SCINTILLATION COUNTERS. Alves, M. A. F.; Policarpo, A. J. P. L.; Dos Santos, M. C. M. (Univ. of Coimbra, Portugal). Nucl. Instrum. Methods; 111: No. 3, 413-418(1973).

A xenon gas proportional scintillation counter working in or very near the ionization chamber region was tested under high x-ray fluxes from a ^{55}Fe source. Within about 0.4% no intrinsic peak shift was detected up to 90,000 c/s, and practically no resolution deterioration was observed up to 40,000 c/s. Preliminary results concerning the variation of the light output and resolution with pressure are also reported. (auth)

27427 MONTE-CARLO CALCULATION OF RESPONSE OF MOXON-RAE DETECTORS. Jhingan, M. L.; Lal, B.; Iyengar, K. V. K. (Tata Inst. of Fundamental Research, Bombay). pp 515-516 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27428 GAMMA-RAY ABSORPTION COEFFICIENT BY DIGITAL METHOD. Ramani (Bangalore Univ., India); Puttaswamy, N. G.; Adiga, B. S.; Sankaranarayanan, P. E. pp 531-536 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27429 RISE TIME OF CHARGE PULSES IN COAXIAL Ge(Li) RADIATION DETECTORS. Garg, R. K.; Bajaj, M. M.; Gupta, S. L.; Saha, N. K. (Univ. of Delhi). pp 545 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27430 FINITE SOLID-ANGLE CORRECTION FACTORS FOR Ge(Li) DETECTORS. Iyengar, K. V. K.; Roy, A. (Tata Inst. of Fundamental Research, Bombay). pp 547 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27431 THIN FILM DETECTOR RESPONSE TO THE PASSAGE OF ACCELERATED HEAVY IONS. Muga, M. L. (Univ. of Florida, Gainesville); Griffith, G. L.; Schmitt, H. W.; Taylor, H. E. Nucl. Instrum. Methods; 111: No. 3, 581-585(1973).

The response of a thin film detector (TFD) to the passage of heavy-mass ions (^{16}O, ^{35,37}Cl, ^{40}Ar, ^{79,81}Br, ^{127}I) as a function of incident energy, velocity and energy loss is reported. Over the range of energies studied a basic dependence of the TFD response on the atomic number and velocity of the transiting heavy ion is observed. The sensitivity of the TFD response to atomic number appears to increase with higher velocities. The observed trends are consistent with those expected on the basis of transiting light-mass ion response studies. Useful applications of this novel de-

tector to heavy-ion reaction studies now appear to be feasible. (auth)

27432 IMPROVING THE RESOLUTION OF HIGH GAIN CHANNEL PLATE ARRAYS FOR PARTICLE AND PHOTON COUNTING. Washington, D. (Mullard Research Labs., Redhill, Eng.). Nucl. Instrum. Methods; 111: No. 3, 573-576(1973).

High gain can be obtained by using two channel plates in cascade, but this results in loss of spatial resolution. The gain of a single plate is normally restricted by the onset of ionic feedback. The improved ionic feedback performance of cascaded plates is explained from the equipotential distribution, and an arrangement is proposed which does not suffer loss of resolution. The possibility of an alternative solution using a single plate made from bulk conducting material is also considered. (auth)

27433 AREA MONITOR AND INTERLOCK SYSTEM FOR THE X-RAY DIFFRACTION LABORATORY. Howard, R. M. (Jones and Laughlin Steel Corp., Pittsburgh). Health Phys.; 25: No. 5, 517-519(Nov 1973).

A device is described whereby an entire x-ray diffraction laboratory (area $\simeq 25$ ft^2) is monitored. When the radiation level exceeds a preset, safe limit the source is automatically deenergized. The overall system is shown and consists of two Geiger tubes, installed permanently in the ceiling over the diffractometers, serving as detectors and a ratemeter which provides a contact closure if a preset count rate is exceeded. The reliability of the system has been tested over a year. (UK)

27434 ELEMENTS OF THE INPUT STAGE OF LOW-NOISE PREAMPLIFIERS. Sedov, N. Ya.; Blinnikov, Yu. S. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 472-475(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 122-125(1973).

Elements are selected for the input stage of low-noise preamplifiers used with Ge(Li) detectors. It is shown that one can use PSO, PO, and FT-1 capacitors as an isolating capacitor for detector biases of up to 2 kV, even though their nominal voltages are 500, 300, and 600 V. It is likewise shown that a KT345 transistor is more appropriate for cascade connection with a field-effect transistor from the point of view of obtaining the best noise characteristics of spectrometer preamplifiers. (auth)

27435 LIGHT FEEDBACK IN A LOW-NOISE PREAMPLIFIER. Tret'yakov, V. A.; Popeko, L. A. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 476-478(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 125-127(1973).

A low-noise preamplifier with light feedback based on field-effect transistors and light-emitting diodes is described. The energy resolution with a Si(Li) detector having a capacitance of 3 pF is 360 eV relative to the generator. (auth)

27436 CERTAIN CHARACTERISTICS OF DIRECT-CHARGE DETECTORS. Baranov, V. F.; Ivanov, V. I.; Kulakov, G. V.; Makhaneva, G. I. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 2, 250-253(Feb 1973).

Translated from Izmer. Tekh.; 16: No. 2, 58-60(Feb 1973).

Direct-charge detectors consist of a system with electrodes made from different materials and spatially separated in vacuum. The principle of their operation is based on measuring the difference of potentials between electrodes which are charged under the effect of the penetrating radiations. The efficiency of the detectors' operation in γ-radiation fields depends on the efficiency of converting γ-quanta fluxes into electron streams and is determined by the difference in atomic numbers of the electrode materials. The resulting difference current of electrons serves, according to the generalized principle of Hurst, as a measure of the γ-radiations dosage field. Relations for determining the detector's sensitivity by measuring the current (dose rate) and by measuring the voltage (dose) are given. (WHK)

27437 PULSE DISCRIMINATION ACCORDING TO THE RISE TIME. Barabanov, I. R.; Syuntyurenko, O. V. (Inst. of Nuclear Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 440-442(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 95-97(1973).

A circuit is described for pulse discrimination according to the rise time, which operates together with a proportional counter. The circuit allowed the background from relativistic electrons having energies ~14 keV to be reduced by a factor of 60. (auth)

27438 SLOW-NEUTRON DETECTORS THAT ARE SENSITIVE TO THE SPOT OF PARTICLE PASSAGE. Deme, Sh.; Pepelyshev, Yu. N. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 345-353(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 7-15(1973).

Existing neutron detectors and those proposed in the literature which are sensitive to the passage of particles are described. The principles of operation and the comparative characteristics of one-dimensional, two-dimensional, and three-dimensional detectors are described which are especially convenient in investigating small-angle scattering of neutrons. The specifics of the measurement electronics for various types of detectors are described, and various versions are presented. (auth)

27439 ELECTRON MULTIPLIER PULSE-HEIGHT DISTRIBUTIONS FOR keV IONS. Miyake, H. (Kobe Univ., Japan). Shitsuryo Bunseki; 21: No. 2, 159-169(Jun 1973).

Pulse height distributions of the output of a secondary electron multiplier for various kinds of ions in the keV region were measured and analyzed to determine the true detection efficiencies for these ions. A high-sensitivity mass spectrometer was used for the measurement at residual gas pressures around 10^{-9} torr. An Allen-type secondary electron multiplier of 12-stage Cu-Be dynodes connected to a low-noise charge-sensitive preamplifier was used for detecting keV ions. It is assumed in the analysis that the pulse height distribution can be obtained from Polya statistics. The pulse height distributions for the ions of which secondary electron yields were markedly different made it possible to estimate the pulse height distribution for the single electron emitted from the conversion dynode. It was made clear that the statistics of the secondary electron emission by the light ions, e.g., H^+, H_2^+, and He^+, was different from that by the heavy ions, e.g., Ar^+, CO^+, and CO_2^+. (auth)

27440 RADIATION INDICATOR. Lippman, R. L.; Sunderland, J. C. (to Capintec, Inc.). US Patent 3,748,476. 24 Jul 1973. Filed date 23 Sep 1971. 8p.

A radiation indicator for receiving extremely small currents, such as from an ionization chamber, and for converting same to a visual output indicative of the strength of a radioactive source under test is described. The radiation indicator includes a varactor bridge operational amplifier circuit, a circuit for eliminating the effects of background radiation, a calibration circuit for adjusting the gain of the radiation indicator in accordance with known radioisotope characteristics, a six-position range adjustment, and circuitry for optimizing the compromise between noise and response time. (Official Gazette)

27441 TEST PROCEDURES FOR GERMANIUM GAMMA RAY DETECTORS. New York; Institute of Electrical and Electronics Engineers (1971). 19p. (ANSI-N42.8).

A standard procedure for determining the characteristics of Ge detectors is prescribed. Measuring methods for determining the energy resolution, counting efficiency, and timing properties are described. (WHK)

Radiation Dosimeters

27442 (AED-CONF-71-400, pp 21-38) DOSIMETRY OF PHOTON AND ELECTRON BEAMS. Reich, H. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

A survey is given of the basic principles, aims and most important measuring procedures in dosimetry and of measuring installations at the Physikalisch-Technische Bundesanstalt. (tr-auth)

27443 (AED-CONF-71-400, pp 243-250) CALORIMETRIC DETERMINATION OF THE ENERGY DOSE IN THE RANGE OF ULTRAHARD RADIATION. Engelke, B. A.; Hohlfeld, K. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

A quasi-adiabatic calorimeter for the determination of the energy dose in graphite is described which was used to determine the dose at 60, 90, and 120 MeV. Under the same conditions, the cavity ion dose was measured by an ionization chamber similar to the calorimeter system. The required energy for the production of an ion pair was determined by comparing the energy dose with the cavity ion dose. (tr-auth)

27444 (AED-CONF-71-400, pp 449-455) STUDY ON THE SUITABILITY OF SILICON PHOTODIODES AS MONITOR AND DOSIMETER FOR HIGH-ENERGY ELECTRONS. Feist, H.; Koep, M.; Reich, H. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The operation and performance of a silicon photodiode for monitoring electron beams at the 5.8-MeV microtron are discussed. (WHK)

27445 (AERE-R-7275) LATENT IMAGE STABILITY IN KODAK RM FILMS. Gibson, J. A. B.; Brown, A. R.; Docherty, J. (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

The stability of the latent image was investigated in order to provide an estimate of the possible errors introduced by changes in temperature and humidity after irradiation of a film dosimeter. Temperatures ranged from 0 to 30°C at humidities from 0 to 100% R.H. with storage periods of up to 35 days following an irradiation. The effects of the radiation quality were investigated by comparing the latent image stability for ^{226}Ra, ^{60}Co and ^{241}Am radiations. The results showed that for typical conditions of 56% R.H. at 22°C the maximum error in the film issued monthly and fortnightly would be ±6% and ±7%, respectively. Control films are to be irradiated on days 23 and 9, respectively and stored at 56% R.H. and 22°C. At humidities of 76% (22°C) the maximum error is increased to 20% but at reduced temperatures this error is reduced. The stability of the image is also much better for ^{241}Am and fading of less than 4% was observed over a period of 35 days at 56% R.H. and 22°C. Limited results for the slow emulsion of the film showed no significant difference in fading from the combined emulsions over a period of 35 days. (auth)

27446 (CONF-731008-2) PROGRESS IN THE DOSIMETRIC APPLICATIONS OF EXOELECTRON EMISSION. Becker, K. (Oak Ridge National Lab., Tenn.). 1973. 18p. Dep. NTIS $3.00.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (1 Oct 1973).

Exoelectron phenomena are used currently as a research tool in solid-state physics, to detect structural damage in metals, and in radiation dosimetry. Progress in this latter field during the last three years is reviewed briefly. It includes some work on optical stimulation, but mostly on thermal stimulation techniques. The search for new material has centered around metal oxides (BeO, Al_2O_3, with and without "activators") and mixtures of oxides including ZnO, SiO_2, TiO_2 and BaO. Closed GM-tube TSEE detectors have been developed, but bare discs of ceramic BeO:Si continue to be the most popular material. In the instrumentation field, the counter characteristics are now better understood, and improved counters have been designed. Ionization chambers have been employed successfully in high dose level readers. Among the various applications of TSEE dosimeters, interface dosimetry, measurement of low-energy (tritium) beta radiation, and fast neutron dosimetry via recoil proton registrations were most notable. Some recent data from ORNL on the directional and energy response of fast neutron TSEE dosimeters are given. Although unsolved problems still persist in preparing and reading out on a routine basis large quantities of detectors, their high radiation sensitivity in a very small sensitive volume offers unique advantages in several areas of radiation research. The general outlook for exoelectron dosimetry is cautiously optimistic. (49 references) (auth)

27447 (CONF-731008-3) PRACTICAL TSEE DOSIMETRY SYSTEM BASED ON BeO CERAMIC. Gammage, R. B.; Cheka, J. S. (Oak Ridge National Lab., Tenn.). 1972. 5p. Dep. NTIS $3.00.

From 4th international symposium on exoelectrons emission and dosimetry; Liblice, Czechoslovakia (1 Oct 1973).

The present situation regarding the practical application of BeO ceramic TSEE dosimeters is assessed critically. Reproducibility of response is the central issue and one which is still causing problems. Nevertheless, the methods of detector preparation, use and readout are established which permit successful testing under field conditions. Examples are given of personnel and environmental monitoring, and of the monitoring of β emitters such as ^{3}H and ^{204}Tl for which the TSEE dosimeter is intrinsically suitable. (auth)

27448 (UCRL-51353) ROLE OF Li_2O ON THERMOLUMINESCENCE IN ^{7}LiF. Toy, A. J. (California Univ., Livermore. Lawrence Livermore Lab). 28 Mar 1973. Contract W-7405-eng-48. 29p. Dep. NTIS $3.50.

Thesis.

Li_2O was added to pure ^{7}LiF, and single crystals with varying amounts of oxygen were grown. The thermoluminescent response of these crystals to ionizing radiation indicates that the added oxygen functions as a luminescence center. (auth)

27449 GRAPHICAL DATA ACQUISITION OF ISODOSES. Genty, P. (CNRS, Orsay, France); Zahlot, G.; Marty, P.; Verel, M. Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 119-121 (Apr 1973). (In French).

A graphic data acquisition system based on the optoelectronic measurement (by transparence) of the isoopacities proportional to the different radiation intensities is presented. (FR)

27450 PERSONNEL MONITORING WITH FILM AND THERMOLUMINESCENT DOSIMETERS FOR HIGH EXPOSURES. Beck, W. L.; Cloutier, R. J.; Watson, E. E. (Oak Ridge Associated Universities, TN). Health Phys.; 25: No. 4, 421-425 (Oct 1973).

If a worker receives a life-threatening radiation exposure his monitoring device should be sufficiently accurate to influence the therapy program. The merits of film and thermoluminescent (TL) dosimetry for routine personnel monitoring have often been compared but not at high exposures. Clinical total-body irradiations have provided a unique opportunity to compare the response of film and TL dosimeters to ^{60}Co gamma rays in the exposure range from 10 to 250 R. Forty-two patients wore both film badges and LiF dosimeters during their irradiation at 1.5 R/hr. During their treatments, which lasted from 3 to 10 days, patients were permitted to move about the exposure room. The average chest exposure from film measurements was 95 ± 27% and from TL measurements was 74 ± 5%. Cobalt-60 depth-dose calculations indicate that the chest exposure should be about 75% of the room-center exposure because of absorption by the patient's body. The over-response of the film may be due to its energy dependence since there is considerable low-energy scattered radiation in the treatment room. Some variability in the measurements can be attributed to difference in size of patients and their positions within the room. However, film exposed on the same patient often showed response differences of more than ±50%; whereas the maximum difference for TL dosimeters on all patients was about ±15%. (auth)

27451 EFFECTS OF ANNEALING AND COOLING PROCESSES ON THERMOLUMINESCENCE OF LiF (TLD100). Dhar, A.; DeWerd, L. A.; Stoebe, T. G. (Univ. of Washington, Seattle). Health Phys.; 25: No. 4, 427-433(Oct 1973).

The influence of annealing procedures and cooling rates on the sensitivity of the thermoluminescent glow peaks in LiF (TLD100) were investigated. Sensitivities obtained after annealing in air, argon or vacuum at several temperatures, followed by cooling at various rates, are correlated with the lattice defect structures present in this material. This correlation allows the formulation of annealing procedures which will maximize the main dosimetry peak sensitivity. Annealing in vacuum at 500°C for 1 h, for example, increases the main dosimetry peak sensitivity by about 30% compared with the same annealing procedure in air. The standard preirradiation anneal of 80°C for 24 h may be shortened to 9 h with only a 3.9% error in integrated intensity, or may be eliminated entirely for peak height measurements. A summary of recommended annealing procedures is included. (auth)

27452 STUDY OF THE CHARACTERISTICS AND APPLICATIONS IN DOSIMETRY OF LIQUID-DIELECTRIC IONIZATION CHAMBERS. Giova, A. Securitas; 57: No. 2-3, 161-223(1972). (In Italian).

Results of experiments made with 2 ionization chambers, one flat and the other cylindrical, filled with high-purity n-hexane are discussed. Instrument response was studied in relation to various parameters and for exposure to ^{60}Co γ-ray sources and Po-Be and Am-Be neutron sources. The provided dose rate was not too high, and there was a linear relation between current and dose even at low polarization tensions; such a feature had not been previously demonstrated. A study of quality-factor measurement in a mixed γ- and neutron-field resulted in the calibration of a flat chamber which enabled unknown quality factors to be determined with an accuracy of 20 to 30% which is acceptable for radiation protection purposes. (Occup. Saf. Health Abstr.)

27453 DIFFICULTIES ASSOCIATED WITH THE USE OF SMALL COLLECTING ELECTRODES IN EXTRAPOLATION CHAMBERS. Supe, S. J. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 545-547 (Sep 1973).

To evaluate the radiation dose on the surface of a small β-ray source or of a nonuniform β source using an extrapolation chamber, the size of the detector has to be reduced and this reduction leads to errors in previously suggested methods of evaluation of the sensitive volume. Furthermore, the volume of the insulating groove between the central collecting electrode and the guard ring can be significantly large compared with the collecting volume of the extrapolation chamber at small diameters of the collecting electrodes and, if neglected, will cause errors. These factors are considered in the present work. It is shown that once an appropriate correction for groove volume is applied, particularly for small diameters of collecting electrodes, the apparent discrepancy between dose rates measured with large- and small-

diameter collector electrodes is diminished, and an agreement within ±3% is obtained. (UK)

27454 THERMOLUMINESCENT DOSIMETER. Kuzmine, V. V.; Mukhine, G. I.; Sokonov, A. D. (to Institut Priborostroienia). Russian Patent 206,729. 18 Jan 1966. (In Russian).

A thermoluminescent dosimeter is described for fast neutrons consisting of a heavy, charged particle radiator, a thermoluminophore for registering particles from the radiator, and an electrical heating source. To increase the sensitivity of the dosimeter to neutron doses and to decrease the threshold of registrable doses, one uses the thermoluminophore with a sensitivity with respect to heavy and light charged particles of at least 20 and the linear dimension of the volume in which the thermoluminophore is placed in the direction of propagation of the charged particles has a size of the order of the electron paths. The thermoluminophore and the radiator are hermetically sealed from the exterior medium. (TSS)

27455 RADIOACTIVITY DOSIMETER SIMULATOR. (to Societe Industrielle des Nouvelles Techniques Radioelectriques et de l'Electronique Francaise). French Patent 2,145,420. 15 Jul 1971. 18p. (In French).

A radioactivity dosimeter simulator intended for use in conjunction with a radioactivity simulator emitting radio signals is presented. The system involves a signal receiver, and an electric pulse generator in the form of a relaxation oscillator functioning with a unijunction transistor whose frequency is controlled by the voltage developed across the receiver. The pulses are integrated and fed into a differential amplifier whose dc output voltage represents the difference between the integrated voltage and a reference potential and is used to measure the simulated radiation dose. A prototype device developed utilizes either a real fountain-pen type dosimeter or a direct reading device; in another prototype the pulse generator is used in conjunction with a radiation meter. (FR)

27456 CONDUCTIMETRIC STUDY OF CELLULOSE NITRATE AS A SOLID-STATE TRACK DETECTOR. Roux, F.; Bourdeaux Pontier, M.; Bisset, J. P.; Briand, C. (Univ., Marseille). Int. J. Appl. Radiat. Isotop.; 24: No. 9, 501-508(Sep 1973). (In French).

The different methods for the reading of solid-state track detectors are considered. An original method determining the dose received by cellulose nitrate irradiated by fission fragments or α particles is suggested. The technique depends on a change in electrical conductivity of the detector after being irradiated and etched by soda. It is possible to determine very high doses of irradiation by this rapid and precise method. (auth)

27457 PORTABLE NUCLEAR DOSIMETER. Jordan, K.; Kuehnert, H. (to Frieseke and Hoepfner GmbH). German Patent 1,802,820. 27 May 1970. Filed date 12 Oct 1968. (In German).

A portable nuclear dosimeter that consists of a radiation detector, electronic instruments for estimation, display means, and control means, as well as at least one socket for connection of accessories before branching at the outside is described. On the side of the case carrying the socket there is mounted a cover that can be lowered which carries on its interior a body that is watertight and airtight made of an elastic plastic material of which the outside diameter is sufficiently greater than the inside of the connection for the above mentioned cover to be introduced into the connection socket by aspiration under pressure of the material in the manner of a stopper of a medicine bottle. (TSS)

27458 ACTION OF RADIATION UPON THE AQUEOUS SOLUTION OF CHLORAL HYDRATE AND INDIGO CARMINE. Fujita, S.; Miyata, N. (Nagoya City Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 2, 121-125(Feb 1973). (In Japanese).

Decolorization of the aqueous solution of chloral hydrate and indigo carmine by irradiation is considered. When chloral hydrate is used as a chemical dosimeter, it is not satisfactory on the point of sensitivity. Therefore, an aqueous solution of chloral hydrate and indigo carmine was studied. The dose was estimated using the difference between absorbancy before and after irradiation. The optimal concentrations of chloral hydrate and indigo carmine are 1.0 M and 4×10^{-5} M, respectively. The reaction is not affected by temperature at 3 to 60°C in the case of 200 R irradiation. Dose rate dependency was not found; energy dependency was found. The lower the energy is, the higher is the sensitivity. (auth)

27459 RADIOTHERMOLUMINESCENT MATERIALS AND RADIOTHERMOLUMINESCENCE DOSIMETERS. Kotera, N.; Nishikawa, S.; Sakamoto, H. (to Dai Nippon Toryo Kabushiki Kaisha). US Patent 3,746,651. 17 Jul 1973. Priority date 13 Aug 1969, Japan. 10p.

A complex oxide luminescent material consisting of magnesium oxide-silicon dioxide and containing trace amount of terbium or cerium as an activator shows strong thermoluminescence with the flow peak at ca. 190°C under excitation by means of electron beam or various radiations and thus is useful as the phosphor for thermoluminescent dosimeter. (Official Gazette)

27460 ESTIMATION OF GENERAL ION RECOMBINATION LOSS IN HIGH INTENSITY RADIATION DOSIMETRY. Moriuchi, Y. (Electrotechnical Lab., Tokyo). Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku; No. 736, 1-93(Jan 1973).

To establish a reliable method for ionization measurements in high intensity radiation dosimetry for the general case of homogeneous ionization throughout the chamber volume, low LET radiations such as secondary electrons liberated by the photons were used in the experiments. The m-value of the laboratory air was examined for constant intensity radiations. The extrapolated value of m agreed quite well with the result by Greening's examination. The normal m-value lies in the range from about 27 to 39 for the ion collection factor from nearly unity down to about 0.1. The m-values of the commercially available pure rare gases of He, Ne, Ar, Kr and Xe under atmospheric conditions were measured. The approximate m_s-values were found to be about 10, 16, 20, 26 and 34 for He, Ne, Ar, Kr, and for Xe, respectively. (In this case the m_s of the air is 32.) It can be stated that He is not suitable for precise measurements of ionization density. The Ne may be used only for high ionization densities where the dominant effect by the impurities may disappear. The use of Ar is recommended only in the case of the positive ion current measurement, because the negative carriers are much influenced by small amounts of impurities. The saturation characteristics in the pulsed ionization formed by the pulsed radiations were examined by experiments using the pulsed photon fluxes generated by the electron linear accelerator having an energy of about 16 MeV. Pulse widths of 1, 2, and 4 μs and the ionization intensity of about 0.1 esu/cc/pulse were used. Comparing the Boag-Wilsons' theory with the present experimental results, considerably good agreements were found in the poor saturation regions. As to the condition of the pulse width, the μ-value of the air seemed to lie in the range from about 800 to 1800. Considering the relation between the μ-value and m-value, the above results showed good agreement with the results of the m-value measurements. The saturation characteristics of the parallel plate free air chamber having a small circular aperture for x-ray incidence were examined by comparing with the experimental results. To extend the Scott–Greening's theory to the region of poor saturation, theoretical analysis was attempted in the region including the poor saturation in which the collection factor was less than 0.1. After determining the effective width of the ionizing volume in the chamber $\bar{s}$, it was found that the different saturation curves under different experimental conditions can be represented by only one type of curve which is expressed by the collection factor f and the specified variable of the $\Gamma = V/\bar{s}^2\sqrt{q_0}$. From these results, it is possible to determine the accurate collection factor in the region above 0.01 for low energy photon fluxes of below about 10 keV_{eff} where the estimation error of the $\bar{s}$ shows no serious effect. However, contrary to the above successful empirical results, the attempted three approximate theories were found not so successful for general use but nevertheless they seem to have considerable advantage over the existing theory. (JA)

27461 THERMOLUMINESCENT DOSIMETERS FOR HIGH-DOSE APPLICATIONS. Gorbics, S. G. (Naval Research Labs., Washington, DC); Attix, F. H.; Kerris, K. Health Phys.; 25: No. 5, 499-506(Nov 1973).

CaF_2:Mn, LiF(TLD-700), and $Li_2B_4O_7$:Mn in the forms of powders, chips and Teflon discs have been investigated for possible application in dosimetry at a bremsstrahlung generator delivering exposures up to 4×10^4 R in pulses of $\approx 10^{-7}$ sec duration. The ^{60}Co response per roentgen was investigated over the range 10^3 to 10^6 R. Some degree of supralinearity was found in CaF_2:Mn, hitherto unreported. Sample-to-sample reproducibility at 10^3 R was compared for the different forms of dosimeter. The dose rate dependence was investigated, qualitatively verifying Goldstein's finding (Health Phys.; 22: 90 (1972)) that LiF(TLD-700) exhibits dose-rate saturation above $\approx 10^4$ rad (in silicon) delivered in $\approx 10^{-7}$ sec. Considering handling convenience, low cost for single throw-away use, relatively small divergence from linearity, lack of dose-rate dependence, good reproducibility of response from unit to unit without individual calibration, and similarity of atomic number between the TL phosphor and the desired dose-reference material (Si), the 0.4 mm-thick 5%-loaded CaF_2:Mn-Teflon disc was found to be the dosimeter of choice for this application. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 27997, 28005, and 28877.

27462 (AAEC/E-260) BEHAVIOUR OF HIGH PURITY SEMICONDUCTOR SURFACE-BARRIER NUCLEAR RADIATION DETECTORS AT LOW TEMPERATURES. Lawson, E. M.; Tavendale, A. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The characteristics of a germanium and a silicon surface barrier detector were examined at low temperatures (78 to 5°K). Preliminary results have also been obtained from a gallium arsenide detector. All detectors were fabricated from high-purity material. Below some critical temperature (10°K in germanium and 32°K in silicon) the spectral response to γ-rays deteriorated markedly, particularly for low bias. Near liquid helium temperature, best resolutions of 10.0 keV at 662 keV and 3.0 keV at 122 keV were obtained with the germanium and silicon detectors, respectively. Relative efficiency measurements found no change in the sensitive depth with temperature in contrast to the indications of the capacitance. A model based on field-assisted detrapping is proposed to account for the fact that sensitive depth is independent of temperature. The behavior of the capacitance and the existence of slow components in the pulse risetime are explained in terms of the equivalent circuit of the detector. The energy resolution of the gallium arsenide detector did not change on cooling to 7°K where a resolution of 3.9 keV at 60 keV was measured. (auth)

27463 (AED-CONF-71-400, pp 63-74) NEUTRON TIME-OF-FLIGHT SPECTROMETER OF THE CBNM, GEEL: TRANSMISSION EXPERIMENTS. Boeckhoff, K. H. (Euratom, Geel, Belgium). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

27464 (AED-CONF-71-400, pp 251-261) ABSOLUTE MEASUREMENT OF QUANTUM FLUX. Borchert, H.; Ziegler, B. (Max-Planck-Institut fuer Chemie, Mainz). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The design and mode of operation of a magnetic Compton spectrometer, calculated with the Monte Carlo method (e.g., multiple scattering and energy loss of the Compton electrons in the conversion target) are described. The operational values thus obtained enable absolute measurements of pulsed quantum fluxes (bremsstrahlung >100 MeV) to be made. (GE)

27465 (BNWL-1751(Pt. 2), pp 51-53) DEVELOPMENT AND APPLICATION OF AN ANTICOINCIDENCE SHIELDED BETA-GAMMA-GAMMA MULTIDIMENSIONAL SPECTROMETER. Brodzinski, R. L.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The system provides the required low backgrounds in addition to high efficiency for low-level counting of environmental materials. Background counting rates, sensitivities, and minimum detectable activities are tabulated. (WHK)

27466 (BNWL-1751(Pt. 2), pp 53-54) GOLD AS A BACKSCATTER ABSORBER IN MULTIDIMENSIONAL GAMMA-RAY SPECTROMETERS. Brodzinski, R. L. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The performance of a gold absorber for covering the line-of-sight area between the NaI(Tl) detectors in a multidimensional gamma spectrometer for reduction of Compton background is described. (WHK)

27467 (FEI-276) INFLUENCE OF SPECTROMETER RESOLUTION AND INITIAL BEAM ENERGY SPREAD ON THE SHAPE OF THE SPECTRUM OF INELASTICALLY SCATTERED NEUTRONS. Kornilov, N. V. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 14p. (In Russian). INIS.

Questions on the distortion of the spectra of inelastically scattered neutrons were examined. The neutron spectra were measured with a time-of-flight spectrometer because of the energy spread of the incident beam and the finite resolving power of the spectrometer. A comparative discrimination of the actual and measured spectra was given in the form of an expansion in the central moment of the resolution function. The dependence of the parameter T of the Maxwell evaporation spectrum on the discrete resolution function was determined. It was established that the effect of these factors is small. The change of the parameter T is ≤0.5% for a dispersion of ≤5 ns. (tr-auth)

27468 (HMI-B-139) STUDY ABOUT THE DISC-MEMORY ORGANIZATION FOR THE TIME-OF-FLIGHT EXPERIMENT NDV 14. Bossel, J. B.; Abend, P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jul 1973. 43p. (In German). Dep. NTIS (U.S. Sales Only) $4.25.

The NDV 14 experiment records 24 × 2 K spectrum from 12 detectors and uses a disc memory for storing the data. A mathematical formulation of the data reduction which is used to find the limitations applied to the experiments through the disc to define four strategies and to analyze them is presented. (auth)

27469 (LA-5379-MS) COMPUTER-ORIENTED GAMMA SCAN SYSTEM. Martin, E. R.; Jones, D. F. (Los Alamos Scientific Lab., N. Mex.). Sep. 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

A general operating and maintenance manual for the upgraded segmented gamma scan assay system is presented. The system, employed for the assay of ^{238}Pu and ^{239}Pu, is built around a Northern Scientific 710 Pulse Height Analyzer and uses a minicomputer on line for data acquisition and reduction. It gives segment-by-segment assay for fissile content profile as well as final sample assay and propagated statistical error. (auth)

27470 (LIB/TRANS-348) SPECTROMETRIC CHARACTERISTICS OF GERMANIUM DETECTORS WITH RADIATION DEFECTS. Stolarova, E. L.; Volodiv, S. N.; Platov, A. I.; Sameldov, V. V. Jan 1973. Translation of IAEA Paper SM-143/61. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The results of studies on the spectrometric characteristics of a germanium detector based on radiation defects are given. The valuable properties of detectors of this type are that they can be stored at room temperature and repeatedly cooled to 70°K and heated to 300°K. They have a thin dead layer so that they can be used extensively in the measurement of low-energy gamma rays and characteristic x-rays. The detector was studied in a gamma-spectrometer system with a charge-sensitive low-noise preamplifier. The basic characteristics of a detector are given. The linearity of the spectrometer lies within experimental errors in the energy range investigated, i.e., 122 to 1333 keV. Data are also given from studies on the relationship between photo-contribution and gamma-ray energy, together with the authors' evaluations of the life-time and relative loss of charge carriers. (AT)

27471 (STU-71-441-U-342) DEVELOPMENT OF LITHIUM DRIFTED GERMANIUM DETECTORS. Rosencrantz, B.; Lauber, A. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1972. 14p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

A production method for large lithium compensated coaxial semiconductor detectors (so called Ge(Li)-detectors) is described. Choice of crystal substance, lithium diffusion, boiling drift process, clean-up drift, surface treatment and positioning in a cryostat are discussed. The described production method is now well established and produces Ge(Li) detectors of very good quality. A technique has been developed for production of well type germanium detectors. These detectors have a cylindrical, coaxial hole and are suited for measurement of samples of low activity, for example in connection with activation analysis. Data are presented on effectivity and stability, optimization of the preamplifier, and resolution of the system, etc. (SW)

27472 (UAE-NPL-1056) RECENT DEVELOPMENTS IN SUBNANOSECOND TIMING WITH COAXIAL Ge(Li) DETECTORS. White, D. C. S.; McDonald, W. J. (Alberta Univ., Edmonton. Nuclear Research Centre). Aug 1973. 36p. Dep. NTIS (U.S. Sales Only) $4.00.

A pulse shape discrimination technique has been developed using a dual constant fraction discriminator combination to analyze γ-ray pulses from a Ge(Li) coaxial detector in order to obtain improved time resolution for this type of detector. A theoretical analysis of the pulse shapes from a coaxial detector as a function of the position of irradiation in the detector, and the synthesis of these pulses in a constant fraction pulse height discriminator have been completed to form a theoretical base to the technique. Typical results for coincidence measurements using a 23 cc coaxial detector and a plastic scintillator are 1.09 ns FWHM and 2.02 ns FW (0.1) M for a γ-ray energy range of $1.10 \leq E \leq 1.35$ MeV and 650 ps FWHM for a 3.16 MeV γ-ray. (auth)

27473 MEASUREMENT OF FAST-NEUTRON (APPROX. 14 MeV) SPECTRA BY A PHOTOEMULSION METHOD WITH A HIGH ENERGY RESOLUTION. Automation of the Measurement. Belovitskii, G. E.; Voronkov, A. E.; Kolesnikova, L. N.; Latyshova, R. A.; Sukhov, L. V.; Shtranikh, I. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 112-122(1972). (In Russian).

Most differential cross section measurements in scattering studies have been performed with the time-of-flight technique because the nuclear photoemulsion method was characterized by inferior resolution and was very time-consuming. The proton-recoil in photoemulsion method is advocated for determining the energy spectra of ~14 MeV neutrons with an energy resolution of ~300 keV (time-of-flight = ~450 keV). Semiautomatic apparatus with coded counters is described for measuring the geometrical parameters of charged particle tracks in photoemulsions. The speed of collecting the statistical data was improved by at least a factor of five. (tr-auth)

27474 MU FOURIER SPECTROMETER: ITS THEORY, DESIGN, AND APPLICATION. Backes, R. J. Columbia, MO; Univ. of Missouri (1972). 137p. University Microfilms Order No. 73-21,764.

Thesis (Ph.D.).

The theoretical features of an experiment for measuring neutron time-of-flight (tof) spectra by means of a Fourier spectrometer are discussed. The chopper frequency range and mesh necessary to reproduce simple theoretical tof spectra are investigated. The resolution of the MU Fourier spectrometer is shown to be dominated by the width of the incident neutron beam, Bragg-reflected from a pyrolytic graphite crystal. Variations in the width of the nearly normally distributed incident beam of 5×10^{-5} eV are shown to be detectable with the Fourier instrument; thus its resolution is ideal for studying diffusive motions in liquids where the broadening of the quasi-elastic peak is typically between 1×10^{-4} and 5×10^{-3} eV. The design of the Fourier chopper, scintillation detector unit, and the associated electronics is discussed. Measurements of tof spectra of ammonium chloride, pentane, and methyliodide are shown to discourage the use of the Fourier spectrometer for measuring complex spectra (ammonium chloride), but to encourage its use for measuring simple spectra (liquid pentane, liquid methyliodide). A unique double filter experimental technique, which can determine the quasi-elastic region of the tof spectra with as few as 250,000 total neutron counts, is demonstrated. (Diss. Abstr. Int. B.)

27475 COMPARISON OF SPECTROMETERS REGARDING EXPERIMENTS WITH HEAVY IONS. Martin, S. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The specifications of various magnetic spectrographs are presented. Detailed comparisons of individual types may lead to an evaluation which, however general, orients to special physical measuring programs. A generally valid concept for the layout of an optimum spectrograph is not possible. (GE)

27476 PROJECT PROPOSAL: REDUNDATRON, FOR THE SEPARATION OF REACTION PRODUCTS OF HEAVY ION REACTIONS. Armbruster, P. (Gesellschaft fuer Schwerionenforschung, Darmstadt, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The redundatron is a three-stage arrangement combining high selectivity with a high degree of efficiency. Of all possible combinations of measuring processes, this arrangement is the one with the highest redundancy as far as the determination of mass and charge of the isotope to be identified is concerned. The possible combinations are described and discussed. (GE)

27477 INVESTIGATIONS IN 1972 FOR THE DEVELOPMENT AND DESIGN OF A RF SEPARATOR. Krueger, F. R.; Persson, B.; Kankeleit, E. (Technische Univ., Darmstadt, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

A report is given on the development work of a HF-separator for heavy ion beams. In particular, ion optical problems are dealt with. (GE)

27478 STATE OF THE Q3D SPECTROMETER PROJECT IN MUNICH. Extract from the Annual Report 1972 of the Accelerator Laboratory of the TUM and LMU. Glaessel, P.; Huenges, E.; Kreuzer, H.; Loeffler, M.; Maier-Komor, P.; Roesler, H.; Scheerer, H. J.; Vonach, H. (Technische Univ., Munich). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

A report is given on the first experiments on the Q3D spectrograph in Munich. Following the completion of its building, the ion optical properties of the apparatus were investigated with an experimental ray-tracing method. (GE)

27479 DEVELOPMENT OF A LEAD SLOWING-DOWN-TIME SPECTROMETER FOR FISSILE MATERIAL ASSAY AND FAST REACTOR PHYSICS RESEARCH. Atwell, T. L. Madison, WI; Univ. of Wisconsin (1973). 268p. University Microfilms Order No. 73-15,954.

Thesis (Ph.D.).

A Lead Slowing-Down-Time Spectrometer (LSDTS) has been built at the University of Wisconsin. The LSDTS facility became fully operational in August 1972, and it is currently being used for experimentation in the nondestructive assay of fissile material, for fast reactor physics teaching and research, and for time-dependent neutron slowing-down studies. The engineering design, research and development work which went into the establishment of this facility is reported. The topical matter of the dissertation includes: (a) a comprehensive discussion on the theory behind the operation of the LSDTS, (b) a detailed description of the physical components comprising the LSDTS facility, many of which were either designed and built or modified in the laboratory, and (c) a report and discussion on the operating characteristics of the LSDTS as completed. The LSDTS is an economical, intermediate-energy neutron spectrometer which exhibits a high intensity-per-source-neutron factor and a very low gamma ray background, while generating broad but well-defined energy spectra over a range of mean energies from about 50 keV to 0.1 eV. The internal operation of the LSDTS is governed by the physics of time-dependent neutron slowing-down by elastic scattering in heavy-moderator materials, namely lead. In many experimental aspects, including the time dependence of the mean neutron energy, the behavior and operation of the LSDTS is analogous to that of a conventional time-of-flight spectrometer having a flight path of 5.65 meters. The major components and component groups comprising the LSDTS facility are: (a) A 150 kV pulsed accelerator equipped with a triple pulsing system for the generation of short bursts of 14 MeV source neutrons at the center of the lead assembly by the d-t reaction, (b) a 1.33 meter cubical assembly of high purity lead inside which samples are exposed to the spectrometer's time- and energy-dependent neutron slowing-down distribution, (c) a set of detectors and their associated linear electronics for detection of neutron-sample interactions, (d) a pair of time-of-flight analyzers used to sort detected events as a function of time after the source burst, (e) a small data acquisition system for information storage, minor data processing and data readout, and (f) the timing, gating and control electronics which governs the accelerator's pulsing units, the detector gating circuits, the time-of-flight analyzers and the data acquisition system. (WHK)

27480 PROPERTIES OF THE PARABEL-MASS-SPECTROMETER LOHENGRIN. Moll, E. (Institut Max von Laue, Grenoble, France). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The Lohengrin mass spectrometer which separates the non-thermal fission products according to mass and energy is described. It is suitable for particles with $B \times r = 1$ Telsa x meter and $F \times r = 11$ mV. It consists of a magnetic and an electrostatic sector field. The most important optical parameters are given. (GE)

27481 GEOMETRIC ABERRATIONS OF AN ELECTROSTATIC PRISM SPECTROMETER WITH QUADRUPOLE: OCTUPOLE LENSES. Shpak, E. V.; Polonskii, B. D. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 9, 1550-1557(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1934-1943(Sep 1972).

The geometric aberrations of an electrostatic spectrometer consisting of a symmetric five-electrode prism and two doublets of quadrupole–octupole lenses are determined. The aberrations up to fourth order in the direction of dispersion of the apparatus and up to third order in the perpendicular direction are given. The aberrations of several systems of spectrometers are calculated. (auth)

27482 CAMAC MODULES FOR MULTI-DETECTOR BI-PARAMETER MEASUREMENTS. Durcansky, G.; Glasenapp, D. (Kernforschungsanlage, Juelich, Ger.). CAMAC Bull.; No. 7, 19-20(Jul 1973).

Three types of CAMAC modules have been developed; an 8-channel precounter-coder, a time-of-flight clock, and a bit-handling unit. They are used, together with a computer, for time-of-flight measurements of subthermal neutrons, pulse height analysis, spectrometry, Moessbauer measurements, and a sample-position-dependent neutron scattering. (DE)

27483 SIMPLE AUTOMATIC SAMPLE CHANGER FOR THE GAMMA-RAY COUNTING OF REACTOR-IRRADIATED SAMPLES. Zanders, J. A. J. (National Inst. for Metallurgy, Johannesburg); Bibby, D. M.; Rasmussen, S. E. J. Phys., E (London); 6: No. 10, 973-975(Oct 1973).

The sample changer was developed for use in association with a 60 cm^3 Ge(Li) detector connected to a 4000-channel analyzer, which is used in the analysis of geological samples. The irradiated sample (in powder form) is sealed in a quartz vial contained within a polyethylene capsule. The transportation of capsules to and from the counting station is done pneumatically and is electronically controlled. Careful design of the counting station has reduced the counting errors considerably and the sample changer, which has been in successful operation for a year, permits maximum utilization of the detector system. (auth)

27484 INVESTIGATION OF THE FISSION PROCESS AND NEUTRON-RICH ISOTOPES WITH THE FISSION PRODUCT SEPARATORS JOSEF AND LOHENGRIN. Sistemich, K. (Kernforschungsanlage, Juelich, Ger.); Borgs, W.; Eidens, J.; Fiebig, G.; Grueter, J. W.; Lawin, H.; Rashid, K.; Rajagopalen, M.; Sadler, G.; Asghar, M. (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft. Part A, Nuclear Physics; Heidelberg, Germany (19 Feb 1973).

In 1972 the two big separators for fission products, JOSEF and LOHENGRIN, were completed. JOSEF (Juelich On-line Separator for Fission Products) is at the research reactor DIDO, nuclear research center, Juelich; LOHENGRIN (named after its Wagner tradition of mass separators) is at the high flux reactor at the M. v. Laue–P. Langevin Institute, Grenoble. Both separators have similar tasks; therefore, the experiments they carry out should be agreed upon in a special program. In this lecture both separators are described and some aspects of the measuring program are discussed. (5 figures, 2 tables) (tr-auth)

27485 MULTIWIRE DRIFTCHAMBER WITH HIGH SPACE AND TIME RESOLUTION. Heintze, J.; Walenta, A. H. (Univ., Heidelberg). Nucl. Instrum. Methods; 111: No. 3, 461–465(1973).

A multiwire driftchamber with good space and time resolution was constructed for use in high intensity beams. Measurements with a collimated ^{90}Sr source resulted in a time resolution of 6.4 ns (fwhm) and a space resolution of 0.26 mm (fwhm). The effects of variations of the electrical field within the drift space and of the angular spread of the beam are discussed. (auth)

27486 DETERMINATION OF THE EFFICIENCY CURVE OF A Ge(Li) DETECTOR NEAR THE GERMANIUM K-EDGE (E = 11.104 keV). Rosner, B.; Gur, D. (Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods; 111: No. 3, 577–580(1973).

A method to determine accurately the size of the dip in the efficiency curve of a Ge(Li) detector for energies near and above the K-edge of germanium is given. It is based on the comparison of the detected different ratios of the L_α/L_β X-ray lines emitted after the bombardment of foils of heavy elements from Ta to Bi by 800 keV protons. (auth)

27487 DISCRIMINATION SYSTEM ANALYSIS FOR HIGH RESOLUTION SPECTROSCOPY. Abbattista, N. (Istituto de Fisica, Bari, Italy); De Giorgio, A.; Marino, D.; Plantamura, V. L. Nucl. Instrum. Methods; 111: No. 3, 587–593(1973).

The noise immunity performances of discrimination systems are analyzed in order to overcome (statistically) the limitations associated with the use of a single threshold device. The analysis is carried out by means of a special "discrimination function." (auth)

27488 NEW COMPACT SOFT X-RAY GAS FLOW PROPORTIONAL COUNTER. Cairns, J. A.; Holloway, D. F.; Snelling, G. F. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 111: No. 3, 419–423(1973).

This instrument comprises an x-ray detector and built-in preamplifier. It is easily demountable, giving ready access to the anode wire and electronic components, and has a window assembly which permits thin plastic windows to be mounted in a convenient manner. The anode wire is held in a simple novel arrangement, which allows it to be replaced easily. The instrument operates efficiently inside a vacuum, and its compact dimensions make it especially attractive for use within an x-ray spectrometer. (auth)

27489 SINGULARITIES OF USING CRYSTAL SCINTILLATORS IN NEUTRON SPECTROMETERS. Trykov, L. A.; Tyufyakov, N. D. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 416–419 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 73–76(1973).

A dependence of the shape of the pulse that develops in anisotropic organic scintillators excited by heavy charged particles on the direction of motion of the particle in the scintillator was detected. The possibility of the advantages of using this effect to solve a number of problems in the spectrometry of ionizing radiations (in particular, in the spectrometry of fast neutrons) is demonstrated. (auth)

High Energy Physics Instrumentation

Refer also to abstract 28334.

27490 (CERN-Trans-73-5) EXPERIMENTAL DETERMINATION AND ANALYSIS OF THE GEOMETRICAL DISTORTIONS IN THE PICK-UP TUBE OF A TELEVISION SYSTEM FOR MEASURING TRACK COORDINATES IN A SPARK CHAMBER. Bernshtein, L. I.; Klevalin, V. A.; Petrakov, A. V.; Kharitonov, V. M. (Akademiya nauk Armyanskoi SSR, Erevan. Institut Fiziki). Jun 1973. Translated by R. Luther from EFI-18(73). 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The effect of specific distortions on the trajectory of a vidicon's scanning beam is investigated. Experimental data, obtained by measuring the co-ordinates of a precision test chart with the television system, are used to determine not only the systematic error and the geometrical distortions of the raster but also the order of the approximating polynomial and the required frequency for re-calibrating the television system. (auth)

27491 (IAE-2132) ENERGY RESOLUTION OF CHERENKOV SHOWER SPECTROMETERS. Varfolomeev, A. A.; Glebov, V. I.; Denisov, Eh. I. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 28p. (In Russian). INIS.

The yield of the Cherenkov radiation of electromagnetic showers from the radiator of a high-density shower spectrometer was calculated. The calculated data of the spatial evolution of the shower was used. The dependences of the size of the light yield on the form and material of the radiator and on the energy of the primary particles in the range from 100 to 1000 MeV were obtained. The advantages of the conical form of the radiator guarantee a Cherenkov radiation shower greater by several times than cylindrical forms. The sources of the fluctuations, leading to broadening of spectrometer lines, are discussed. It is shown that fluctuations, comparable with respect to the size of the contribution with the usually considered sources, introduce angular fluctuation of the Cherenkov radiation. A comparison is made of the calculated data and the experimental results. (tr-auth)

27492 (ITEF-930) APPLICATION OF THE OPTICAL SPARK MODULE IN THE SONIC CHAMBER. Panov, A. A. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'noi Fiziki). 1972. 12p. (In Russian). INIS.

A one-gap sonic spark chamber of ~1.2m^2 area is described. The spark gap of the chamber is an optical spark module, in the walls of which holes have been bored. The sonic waves are detected by condenser microphones of up to 1000 mm long outside the module. The module, microphones, and various elements are mounted on a base duralumin frame. A variant of the sonic chamber with one of the electrodes having an area insensitive to ionization due to beam particles is also described. Some characteristics of the chamber are given. (auth)

27493 LOW-TEMPERATURE BUBBLE CHAMBER. Diatchkov, E. I.; Zeldovitch, A. G. (to Obiedinennyi Institut Iadernykh Issledovanii). Russian Patent 283,422. 14 Jul 1969. (In Russian).

A low-temperature bubble chamber is described that consists of a hydrogen chamber suspended by insulated tie bars on the base of the vacuum chamber and a radiator with the coolant in a Dewar system for thermal insulation. To protect the glass of the chamber against contamination by the solidified gases in the Dewar vessel around the glass perforated tube is installed for feeding the noncondensable gas. The tube is equipped with a valve, a filter, and a tube arranged above to remove the contaminated gas, and a pressure regulator in the Dewar receiver. (TSS)

27494 DETERMINATION OF THE GRAIN DENSITY OF PARTICLE TRACKS BY STUDYING THE DISTRIBUTION OF THE LENGTHS OF THE VACANCIES IN A NUCLEAR EMULSION. Virk, H. S.; Bansal, B. K. (Punjabi Univ., Patiala, India). Compt. Rend., Ser. A, B; 277: No. 2, 65–66(09 Jul 1973). (In French).

A systematic study of the variation in length of the vacancies in a track was undertaken. It was shown that the distribution of the average length obeys an exponential law independent of the emulsion development stage. (FR)

27495 CALCULATION BY THE MONTE CARLO METHOD OF THE LINEARITY AND RESOLVING CAPACITIES OF THE CHERENKOV SPECTROMETER FOR γ ASTRONOMY. Dmitriev, B. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1343–1346(Jun 1973). (In Russian).

By means of the Monte Carlo Method a calculation was made of the linearity and resolving capacity of the Cherenkov spectrometer

of TF-1 glass, having the form of a truncated pyramid 3.5 radio units for electron energies of 50, 100, 200, 400, 800, and 1600 m_0c^2 and two points of inclination on the surface of the detector. (tr-auth)

27496 ACOUSTICAL SPARK CHAMBER IN THE TELESCOPE DESIGNED FOR STUDY OF THE PRIMARY COSMIC γ RADIATION. Kruglov, E. M.; Bokov, V. L.; Gorodinskii, G. M.; Derevitskii, Yu. G.; Yuferev, V. S. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1339-1342(Jun 1973). (In Russian).

The effect of the nonlinear character of the propagation of the collision acoustical waves and of the inclination of the track on the precision of the location of the particle track in the acoustical spark chamber was examined. The effect of the purity of the operating gas on the fraction of the energy operating on the formation of collision acoustical waves was studied. The feasibility of the use of a large constant discharge RC with the purpose of decreasing the fluctuations of the spark energy is shown. (tr-auth)

27497 PLASTIC SCINTILLATOR MESON SUPERTELESCOPE AND ITS BONDING COEFFICIENTS. Alent'ev, A. N.; Kolomeets, E. V.; Kupchishin, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1334-1338(Jun 1973). (In Russian).

A description is given of the meson azimuthal super telescope and the multichannel recorder, designed for obtaining data on the numerical printout. The bonding coefficients of the meson components were calculated for different zenith angles with account taken of the telescope geometry. (tr-auth)

27498 IONIZATION CALORIMETER WITH PROPORTIONAL COUNTERS. Babayan, Kh. P.; Boyadzhyan, N. G.; Vasil'tsov, V. V.; Grigorov, N. L.; Sobinyakov, V. A.; Shestoperov, V. Ya. Kosm. Luchi; No. 13, 185-186(1972). (In Russian).

An ionization calorimeter with a system of proportional counters which serve for determining the charge of the particles falling onto the calorimeter and for estimating the multiplicity of the secondary charged particles is described. (auth)

27499 MULTICHANNEL RECORDING AND AUTOMATIC INFORMATION READ-OUT SYSTEM. Bogomolov, E. A.; Evstaf'ev, E. Ya.; Karakad'ko, V. K.; Lubyanaya, N. D.; Romanov, V. A.; Totubalina, M. G.; Yamshchikov, M. A. Kosm. Luchi; No. 13, 189-192(1972). (In Russian).

A system of recording and processing of telescope data for measurement of the EW asymmetry is described. The information is recorded by 45 channels and a continuously moving 35 mm film. Dead time of the recorder is about 0.1 sec. A sorting electronic circuit is used to reduce the errors while recording the statistically time distributed pulses. The recorded information is read out by means of photoresistors. The phototransmitter signals are fed either to the mechanical recorder unit for preliminary procession or to a logical circuit which controls the operation of the punching device. The punched tape is processed by an electronic computer. (auth)

27500 INSTALLATION FOR INVESTIGATING ANGULAR DISTRIBUTION OF COSMIC MUONS OF SUPERHIGH ENERGIES AT GREAT ZENITH ANGLES. Borog, V. V.; Kirillov-Ugryumov, V. G.; Petrukhin, A. A.; Shestakov, V. V. Kosm. Luchi; No. 13, 192-194(1972). (In Russian).

An installation consisting of ionization calorimeter and counter hodoscope allows for registration of cascade showers caused by electromagnetic interaction of the muons of superhigh energies of the cosmic ray horizontal flux. The direction of muon motion is determined by a hodoscope consisting of 1296 counters of the GS 30 type. The information obtained gives an opportunity to restore the angular and energetic distribution of cosmic muons, which permits to determine the mechanism of their generation. Discussed in detail is the accuracy of determination of the angle of the particle passage in addition to the causes which might introduce distortions (like shower accompaniment of muons, escape of shower electrons from the calorimeter, random coincidences, etc.). (auth)

27501 SOME PROBLEMS OF THE DESIGN OF SCINTILLATION AND CHERENKOV COUNTERS. Chukin, V. S. Kosm. Luchi; No. 13, 195-198(1972). (In Russian).

The feasibility of increasing the effectiveness of the scintillation and Cherenkov counters through improving light collection of the registered radiation on the photoelectric cathode of the photomultiplier is studied. Listed are optical and mechanical characteristics ensuring an optical contact between the elements of the optical systems and, particularly, between the elements of the "detector photoelectric multiplier lightguide" system. An example of how to select a detector of the directional Plexiglass Cherenkov counter is given. Also presented are the experimentally obtained amplitude distributions while recording cosmic ray μ-mesons. Stressed is the necessity to obtain agreement between the characteristic spectrum of the photo-cathode of the photomultiplier and the spectrum of the registered radiation. (auth)

27502 INCREASE IN ISOTROPIC PROPERTIES OF DISCHARGE SPARK CHAMBER WITH A BROAD GAP. Nurgozhin, N. N. Kosm. Luchi; No. 13, 204-207(1972). (In Russian).

Investigations were carried out to register particle tracks in the form of sparks or streamers running at different angles towards the chamber's electric field. The investigations were performed with two discharge spark chambers represented by boxes glued with epoxide pitch. Each box consists of 8 mm glass plates with overall dimensions of 100 × 50 × 20 cm. The chambers are filled with neon at 1 atm. The spark chambers were power-fed by a pulse, with an amplitude of 300 kV. Registration of particle tracks in the form of sparks takes place at the track angles $\varphi < 30°$ with respect to the electrical field. If $\varphi > 40°$ the tracks will be registrated in the form of streamers. Particle tracks with respect to the angle are shown. A fully isotropic discharge spark chamber of larger area, registering greater quantities of particles is stated to be feasible. (auth)

27503 THREE-ELECTRODE STREAMER CHAMBER. Nurgozhin, N. N. Kosm. Luchi; No. 13, 201-204(1972). (In Russian).

A three-electrode streamer chamber has been designed with basic components consisting of two glass boxes with overall dimensions 1,000 × 500 × 200 cu mm filled with neon under 1 atm. Serving as the high-voltage pulse source is a nanosecond voltage pulse generator with cutoff dischargers at 16 atm. nitrogen pressure. The dischargers are designed for obtaining an adjustable pulse with an amplitude of 600 kV and nanosecond front. To match the chamber electrodes with the oscillator the electrodes are manufactured in the shape of a three-wire strip line. The cutoff discharger plug-in and the operating instructions are also described. Photographs of particle tracks inside the chamber and the oscillograms of the corresponding high-voltage pulse applied to the chamber are presented. (auth)

27504 GAS THRESHOLD CHERENKOV COUNTERS. Logachev, V. I.; Sinitsyna, V. G.; Chukin, V. S. Kosm. Luchi; No. 13, 207-211(1972). (In Russian).

Two designs of gas threshold Cherenkov counters for registering electrons of primary cosmic rays with $E_e \geq 5$ MeV and recording no protons with $E_p < 10$ BeV are described. Also presented are constructional and technological measures to ensure maximum light collection of the Cherenkov radiation originating on the photocathode of the photomultiplier inside the radiator. The dependence of the reflection factor on the length of the light wave for different coatings as well as the relative throughput of different optical materials employed are illustrated. A range of methods for determining the counters' effectiveness during registration of cosmic ray μ-mesons and ways of its further increase are given. (auth)

27505 INSTRUMENT FOR INVESTIGATING THE COMPOSITION OF COSMIC-RAY ELECTRON COMPONENT. Bogomolov, E. A.; Karakad'ko, V. K.; Lubyanaya, N. D.; Romanov, V. A.; Totubalina, M. G.; Yamshchikov, M. A. Kosm. Luchi; No. 13, 215-220(1972). (In Russian).

A telescope consisting of three spark chambers and two control scintillation counters has been designed and being used for investigating the composition of cosmic ray electron component within the range of energies of 1.0 to 10.0 BeV by the EM asymmetry method. The telescope geometrical factor is ~ 20 cm^2 steradians. Discharges are recorded in the chambers on a photo film. The telescope is oriented to the azimuth with an accuracy of ±3°. (auth)

27506 BACKGROUND ESTIMATION IN (νe)-DIFFUSION DETECTOR. Glotov, V. I. Kosm. Luchi; No. 13, 211-212(1972). (In Russian).

Background conditions for detecting (νe)-diffusion are discussed with reference to the utilization of a hodoscopic system consisting of wide-area flat Geiger counters connected for coincidence and a controllable spark chamber. When calculating the background, any organic compound synthesized from C, O_2 and H_2 (for instance—organic glass) with radioactive admixtures (U, Th, and their allied products), is supposed to be the preferable material for the detector construction. The number of background events simulating the sought effect is estimated by analyzing the spectrum of the organic glass γ-radiation caused by disintegration and fission of long lived isotopes and by nuclear reactions with participation of α-particles and neutrons. (auth)

27507 SPARK CALORIMETER: AN INSTRUMENT FOR DETERMINING PARTICLE ENERGY OF COSMIC RADIATION.

Alakoz, A. A.; Bolotov, V. N.; Devishev, M. I.; Klimanova, L. R.; Shmeleva, A. P. Kosm. Luchi; No. 13, 220-223(1972). (In Russian).

In 1964 a spark calorimeter was installed at NOR-AMBERD station (2000 m above the sea level). Advantages of this calorimeter over the ionization one are illustrated. (auth)

27508 SPARK CHAMBERS FILLED WITH GAS MIXTURE. Akopyan, G. S.; Bostandzhyan, N. Kh.; Marikyan, G. A.; Matevosyan, K. A. Kosm. Luchi; No. 13, 198-201(1972). (In Russian).

The performance of the four-layer spark chamber filled with alcohol vapor at 45 torr and very pure neon at 1 to 4.6 atm as well as filled with only very pure neon at 1 to 2.9 atm. The curves of particle recording effectiveness vs the time of delay in the chamber pulse supply and the number of operations are given. This effectiveness decreases with an increase in time of delay and any addition of alcohol vapors increases the drop of effectiveness in time. However, alcohol vapors improve localization of tracks and make them 3 to 4 times as narrow compared to the tracks inside the chamber filled with very pure neon. (auth)

27509 PLASTIC SCINTILLATION COUNTERS WITH AN AREA OF 2 m^2. Egorov, T. A.; Efimov, N. N.; Krasil'nikov, D. D.; Sleptsov, I. E. Kosm. Luchi; No. 13, 240-243(1972). (In Russian).

Two designs of plastic scintillation counters with an area of 2 m^2 surveyed in each case by a single photomultiplier are described. Radial dependence of their light collection on the place of the path of detected particle does not exceed 10% while the half-width of differential distribution of the pulse amplitudes for non-filtered cosmic radiation at sea level is 90 to 95%, and 65%, the plastic thickness being 5 cm and 10 cm, respectively. The temperature coefficient of the counter is 0.32% per 1°C. (auth)

27510 GENERALIZATION OF FORMULAS FOR IONIZATION ENERGY LOSSES AND COLLISION CROSS SECTION IN THRESHOLD DETECTORS. Ermilova, V. K.; Kotenko, L. P.; Merzon, G. I.; Chechin, V. A. Kosm. Luchi; No. 13, 223-226(1972). (In Russian).

Two types of formulas were obtained for $(-dE/dx)$ and the number of collisions per unit of path length (dN/dx) — const depending on W_m with due account of polarization effect of the medium. (auth)

27511 PROPERTIES OF 1 mm PITCH WIRE PROPORTIONAL CHAMBERS AT HIGH GAIN. Makowski, B.; Sadoulet, B. (CERN, Geneva). Nucl. Instrum. Methods; 111: No. 3, 561-565(1973).

One mm pitch wire proportional chambers were used. Different mixtures of argon, isobutane, freon, and methylal were tried. A gas giving high amplification and standardized pulses was found. The properties of the chamber working in these conditions are shown and compared to chambers having different wire diameters or different pitches. (auth)

27512 SYSTEM OF LARGE MULTIWIRE DRIFTCHAMBERS. Walenta, A. H. (Univ., Heidelberg). Nucl. Instrum. Methods; 111: No. 3, 467-475(1973).

The construction and the properties of large ($\approx$1 m^2) multiwire driftchambers are described. The location accuracy, which depends on the chambers and on the read-out system, is $\sigma = 0.35$ mm. This number was measured with a read-out system designed for the operation of 664 wires. A detailed analysis of σ is given. A set of 7 large driftchambers was operated in a magnetic spectrometer at the CERN PS during the period 1971/1972. Operational experiences are communicated. (auth)

27513 FAST FLASH-TUBE HODOSCOPE CHAMBERS. Brosco, G.; Conversi, M.; Giovannini, M. (Univ., Rome). Nucl. Instrum. Methods; 111: No. 3, 477-484(1973).

A fast type of flash tube has been developed through appropriate choices of the glass, gas filling mixture and externally applied electric fields. Sensitive times in the microsecond region and recovery times of some 10 msec have been obtained, with no relevant long-lasting effects due to charge deposit on the tube walls, as those observed for ordinary flash tubes. Operation of fast hodoscope chambers, in experiments with particle accelerators, presents some advantages over other types of electrically pulsed chambers commonly in use, which are briefly discussed. (auth)

27514 TECHNICAL PROBLEMS INVOLVED IN H_2 STREAMER CHAMBERS. Fohrbach, F. (Univ. of Washington, Seattle); Bonnet, J. J.; Cathenoz, M. Nucl. Instrum. Methods; 111: No. 3, 485-495(1973).

Technical difficulties which must be resolved in order to develop a working H_2 streamer chamber for elementary particle research are discussed. It was found that the minimum requirements for the high voltage pulse are: amplitude 70 to 80 kV/cm for pure hydrogen ($\approx$60 kV/cm with SF_6 or CH_4 impurities) at atmospheric pressure, duration lower than or equal to 6 ns at the base of the pulse and reproducibility better than 2%. A very fast pulse with rise time less than 2 ns and less than 1% jitter has been obtained by using an electrostatic high voltage generator (up to 600 kV) feeding a conical Blumlein line switched at the tip of the cone by a high pressure triggered radial spark gap. With this equipment good pictures of tracks in hydrogen were obtained in a 9 cm gap chamber at various H_2 pressures up to 0.4 atm. The effect of impurities and mixtures of track quality in H_2 has been studied. Comparison with He and He-Ne (75%) gas is given. (auth)

27515 STUDY OF SIGNAL SHAPING AND ENERGY RESPONSE OF LARGE NaI(Tl) SPECTROMETERS FOR APPLICATION AT NAL. Guiragossian, Z. G. T.; Schilling, R. F. (Stanford Univ., CA). Nucl. Instrum. Methods; 111: No. 3, 497-500(1973).

Signal shaping properties are demonstrated with a large NaI(Tl) crystal assembly, 20 in. thick and 30 in. in diameter. Correlated energy resolution responses are shown for total energy absorption in the crystal from 580 MeV electrons. Light collection optics by diffuse reflection most likely determined the 10%-to-90% rise-time of signals of 80 nsec, connected with the transit time of trapped light, before it reaches a photocathode surface. Using a signal clipping technique, the trailing edge of pulses are shaped to have base-lines entirely restored to zero. Providing good energy resolution, signals are obtained which are shaped to have 200 nsec full-width at base. The energy resolution responses from signal pulse-height measurements are demonstrated. Further improvements to obtain shorter pulse-widths are discussed and the capability of these crystals to handle several types of background is shown. (auth)

27516 PROLONGED MONITORING OF AN EXPERIMENTAL INSTALLATION BY MEANS OF SEMICONDUCTOR RADIATORS. Aleksandrov, Yu. A.; Kozlov, V. A.; Kutsenko, A. V.; Maiko, V. N.; Pavlovskaya, V. V. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 422-423(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 79-80(1973).

Data are presented on the long-term stability of a system for monitoring an installation with two Cherenkov total-absorption spectrometers, which uses pulsed semiconductor light sources based on GaP as the source of the standard signal. The use of such a monitoring system for the study of the dynamic characteristics of paths under conditions of large background loadings is discussed. (auth)

27517 COMMUTATOR FOR DATA READOUT. Silaev, A. A. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 424-426(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 81-83(1973).

The commutator performs preliminary handling and writing of the data from pickups in a complex installation in the recording of an extensive atmospheric shower (e.a.s.). The buffer memory of the hodoscopic counter system used to study the shower components on the ground and underground was implemented using TN-0.5 neon lamps. The data on the time delays of the scintillation system for determining the slope angle of the shower axis as well as information on the operate time and the shower number are remembered by trigger counters. The interrogation and writing of data from the pickups of the complex installation on punched type are achieved in 2.5 sec. The subsequent processing and calculation of the physical parameters of the shower are carried out on an electronic computer. (auth)

27518 MULTIFUNCTIONAL LOGICAL NANOSECOND-ELECTRONICS MODULES BASED ON INTEGRATED MICROCIRCUITS. Bushnin, Yu. B.; Dunaitsev, A. F.; Sen'ko, V. A. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 427-429(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 83-86(1973).

Logical modules of a nanosecond-electronics system are described which allow the selection of coincidences or anticoincidences of various multiplicities or performance of logical summation of pulses. The minimum resolving time of the modules is equal to 4 nsec. The circuits of the modules are implemented using integrated microcircuits having a speed of response of 100 MHz. (auth)

27519 MAJORITY 12-INPUT COINCIDENCE CIRCUIT. Bushnin, Yu. B.; Dunaitsev, A. F. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 437-439(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 93-95(1973).

A majority 12-input coincidence circuit is described which

allows selection of the coincidence of logical pulses with a multiplicity ranging from 1 to 6 and a maximum speed of response of 100 MHz. The resolving time of the circuit does not depend on the multiplicity of the coincidences for logical pulses having a triangular shape. The coincidence circuit was used with the accelerator at the Institute of High-Energy Physics together with a system of electronic logic modules. (auth)

27520 POSSIBILITY OF CONTROLLING THE SENSITIVITY OF A PHOTOGRAPHIC EMULSION BY MEANS OF AN ELECTRIC FIELD. Kalashnikova, V. I.; Kolyubin, A. A.; Lemeshko, B. D. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 420-421(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 76-78(1973).

The influence of an electric field on the grain density in the tracks of protons having an energy of 100 MeV was investigated. It was shown that in a nuclear emulsion of the R type, whose emulsion microcrystals have a small number of sensitivity centers, the electric field leads to a reduction of grain density in the tracks of particles, whereas in an experimental emulsion having a large number of sensitivity centers a substantial increase of grain density on the microcrystal is observed. (auth)

27521 MAGNETIC SPECTROMETER FOR RECORDING PARTICLES IN THE RANGE UP TO 4 GeV/c. Abramyan, L. O.; Agan'yants, A. O.; Adamyan, F. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 402-404(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 60-62(1973).

A spectrometer based on standard magnetic elements is described which is used for simultaneous recording of mesons and protons in the range of momenta above 4 GeV/c with a resolution of 1 to 2%. (auth)

27522 INSTALLATION FOR RECORDING NEUTRAL MESONS ACCORDING TO DECAY GAMMA-QUANTA. Didkin, G. N.; Eponeshnikov, V. N.; Krechetov, Yu. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 407-409(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 64-66(1973).

An installation is described for recording correlated $\gamma\gamma$-coincidences. The principal characteristics of the installation are presented. Cherenkov total-absorption spectrometers having an energy resolution of 33 to 18% in the energy range from 100 to 700 MeV were used as detectors. A feature of this spectrometer is the use of a FÉU-49 photomultiplier in the spectrometric and times modes simultaneously. (auth)

27523 TELEVISION COMPLEX FOR TAKEOFF OF INFORMATION FROM NARROW-GAP SPARK CHAMBERS. Gorokhov, V. P.; Gorelova, V. I.; Klevalin, V. A.; Petrakov, A. V. (All-Union Correspondence Electrical-Engineering Inst. of Communication, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 410-413(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 67-70(1973).

A television system for takeoff of information from two projections of narrow-gap spark chambers is described which operates into a line with an electronic computer. The block diagram of the measurement complex, the functional diagrams of the sections, and certain experimental data from laboratory tests of the measurement complex are presented. (auth)

27524 SCINTILLATION HODOSCOPE FOR A MAGNETIC SPECTROMETER. Abramyan, L. L.; Agan'yants, A. O.; Vartapetyan, G. A.; Demekhina, N. A.; Isarelyan, M. Kh.; Lebedev, A. N.; Muradyan, E. G.; Khudaverdyan, A. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 414-415(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 71-72(1973).

Three hodoscopes for a magnetic spectrometer operating at 0.8 to 4.0 GeV/c are described. The hodoscopic counters consist of a row of sequentially positioned scintillation rods that are connected to photoelectron multipliers by bent lightguides. The efficiency of an individual hodoscopic counter is ~97%. (auth)

Radiometric Instruments

Refer also to abstracts 27167, 27329, and 27581.

27525 (INP-818) ANALYTICAL POSSIBILITIES OF THE N-503 TYPE GAS CHROMATOGRAPH WITH A DNW-400A TYPE TRIODE–ARGON DETECTOR. Lasa, J.; Bros, E.; Kosc, Z.; Mendyka, B. (Institute of Nuclear Physics, Krakow (Poland)). 1972. 60p. (In Polish). Dep. NTIS (U. S. Sales Only) $5.00.

A description of the construction of a triode–argon type detector and the results of an investigation on the influence of its active space shape upon the characteristics and the detectivity level are given. On the basis of this investigation, an argon-triode type detector provided with a radioactive source Ni-63 with an activity of 10 mCi was developed. The detector can be used in chromatographic analysis with temperature programming. The effect of the supply voltage on minimum detectivity is presented. Some examples of the application of the described DNW-400A type detector for the analysis of alcohols, aldehydes, ketons, estres, and hydrocarbons are given. (auth)

27526 INNER LAYER POSITION MEASUREMENT. Kurstedt, H. A. Jr.; Thompson, M. L. Jr. (to Industrial Nucleonics Corp.). U. S. Patent 3,754,138. 21 Aug 1973. Filed date 7 Oct 1971. 10p.

An apparatus for measuring the position of a layer disposed within a tire ply, containing metallic particles is described. The inner layer is metal or is coded by providing metallic particles as a tracer material which have a different fluorescence energy from that of the metallic particles present in the tire ply. A source of radiation is directed at the tire ply to cause fluorescence of the layer. Radiation detectors on opposite sides of the tire ply which are sensitive only to the fluorescence energy of the layer, produce signal outputs that are compared to produce a signal which is indicative of the position of the layer within the tire ply. (15 claims, 5 drawing figures) (Official Gazette)

27527 INDUSTRIAL APPLICATION OF X-RAY FLUORESCENCE OF RADIOACTIVE ORIGIN IN THE CONTROL OF THE THICKNESS OF A COATING. Catonne, J. C. (Conservatoire National des Arts et Metiers, Paris). pp 14-16 of Surface States and Transformations. Paris; Compagnie Francaise d'Editions (1972). (In French).

From technical meeting on surface states and transformations; Paris, France (7 Jun 1971).

A method is described for measuring the thickness of a coating (of the order of a few micrometers) on a thin substrate using x-ray fluorescence. The x-rays may be generated externally or in the material under examination (composite source). An industrial thickness gage consisting of a radioactive source, the necessary shielding, a detector, and preamplifier is described. (FR)

27528 BASIS WEIGHT GAUGING APPARATUS, SYSTEM, AND METHOD. Bossen, D. A.; Anderson, E. R.; Dahlin, E. B. U. S. Patent 3,757,122. 4 Sep 1973. Filed date 30 Oct 1972. 10p.

A basis weight gaging apparatus for ascertaining the basis weight of sheet material having a radiation source providing radiation in the form of a succession of events and a radiation detector located to receive the radiation after it has come into contact with the material is described. Counting means scale the events which are received by the radiation detector for a predetermined period of time and these counts are utilized to obtain the weight per unit area measurement of the sheet material. When the basis weight measurements are being made continuously, a standardization means is provided to insure that the basis weight measurements are accurate. (Official Gazette)

27529 NUCLEONIC SEDIMENT CONCENTRATION GAUGE. Comparison of Transmission and Scattering Modes. Krishnamurthy, K.; Rao, S. M.; Rajagopalan, R. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 579-583(Oct 1973).

A comparison of the "transmission" and "scattering" modes of application of an ^{241}Am suspended sediment concentration gage is presented. It is shown both from theoretical considerations and experiments that there can be no significant differences in either mode of operation. The limited practical utility of the gage in hydrological investigations where the sediment concentrations are in the range of 0 to 3000 ppM is also explained. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

27530 (N-71-28025) INFLUENCE OF SPACE RADIATION UPON THE MOS MICROMETEOROID CAPACITOR DETECTOR. Final Report, 17 July 1970–16 February 1971. Monteith, L. K.; Donovan, R. P.; Simons, M. (Research Triangle Inst., Durham, N. C. (USA). Engineering and Environmental Sciences Div.). Feb 1971. Contract NAS1-10232. 55p. (NASA-CR-111892). NTIS.

Four possible failure modes due to electron irradiation are spurious output generated by photocurrents, spurious output due to accumulation of space charge in the oxide, spurious output because of spontaneous discharge of space charge in the oxide, and

detector failure because of increased capacitor leakage current. The first two are discussed and dismissed as negligible. A spontaneous discharge is not likely to create a signal of sufficient magnitude to trigger the counting circuit if only the space charge within the oxide participates in the spontaneous discharge. Complete discharge is unlikely to occur through a small localized region; a more probable failure mechanism is for the spontaneous discharge to initiate a capacitor discharge, which would be indistinguishable from a capacitor discharge triggered by a micrometeoroid count. The capacitors can also be rendered inoperative by greatly increased leakage current because of radiation-induced degradation of the oxide or oxide-silicon interface. Two experiments recommended to assure reliability and accuracy of the detector output are irradiation of a biased detector with 20-keV electrons to maximize space charge buildup and with 300-keV electrons to induce displacement damage. (auth)

27531 (ORNL-TM-4086) ANALYSIS AND SIMULATION OF THE CYLINDRICAL ELECTRIC DIPOLE ANTENNA RESPONSE TO EMP. Barnes, P. R. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 50p. Dep. NTIS $4.50.

The results of the singularity expansion method as applied to the electromagnetic scattering from a thin cylinder are used in the analysis of the electric cylindrical dipole antenna response to electromagnetic pulse (EMP). Simple analytical formulas are obtained for the time-domain dipole short-circuit current response to incident fields with a step function and decaying exponential time histories. Simple analytical expressions are derived for the dominant terms in the solutions of the antenna admittance and the time-domain dipole open-circuit voltage. Also, simple formulas to calculate the load current and voltage responses are developed. For the tuned load with a first resonant equal to the antenna's first resonant frequency, an expression for an upper bound of the EMP energy dissipated by the load during the first half-cycle is developed. Finally, pulser circuits to approximately simulate the half-dipole response based on this work are presented. (auth)

27532 EFFECTIVE RECOMBINATION LEVELS IN N- AND P-TYPE SILICON IRRADIATED BY 4.5 MeV ELECTRONS. Bielle Daspet, D. (Univ., Toulouse). Solid-State Electron.; 16: No. 10, 1103-1123(Oct 1973).

The effective recombination levels created at room temperature by 4.5 MeV electron irradiation are deduced from the variations in lifetime vs carrier injection rate, electron fluence, and temperature. The properties of the created recombination energy levels and defect centers in N- and P-type silicon single crystals are compared. The characteristics of the samples used extend over a wide range of resistivities, doping impurities and crystal growth techniques. A pulsed neodymium laser has been employed to carry out these studies, and the carrier lifetime has been measured by the photoconductivity-decay method. Information on the specific centers is deduced from the comparison of the present macroscopic results on energy levels and annealing studies with the known properties of microscopic defects. (auth)

Miscellaneous Instruments

Refer also to abstracts 27179, 27218–27220, 28989, 29052, 29201, 29202, 29485, 29547, and 29565–29567.

27533 (AD-754897) SMALL ROCKET INSTRUMENTATION FOR POLAR CAP ABSORPTION MEASUREMENTS. Burt, D. A.; Howlett, L. C.; Bell, R. J. Jul 1972. Contract F19628-70-C-0302. 105p. (AFCRL-72-460). NTIS.

During the two year period ending March 31, 1972, ten small rocket payloads were developed and instrumented at the Space Science Laboratory, Utah State University, for the study of polar cap absorption events (PCA). These payloads are part of a continuing program for the development and improvement of small rocket measurements techniques and the investigation of PCA. Instruments were developed which measure electron, positive ion and ozone density, and proton flux. Seven of the ten payloads were launched from Thule, Greenland, and were highly successful. Results of this program have shown that small rockets are indeed a valuable tool for the study of ionospheric parameters. (auth)

27534 (ANL-8033) EFFECTIVENESS OF A TRACE HEATING CABLE AS A LIQUID-SODIUM LEAK DETECTOR. Kumar, R.; Raue, D. J. (Argonne National Lab., Ill.). Jul 1973. Contract W-31-109-Eng-38. 7p. AT.

The use of metal-braid-sheathed, asbestos-insulated heating cable as a liquid-sodium leak detector is described. Detection of a sodium leak is based on measurement of the drop in resistance of the insulation upon impregnation by the liquid sodium. In simulated sodium-leak tests, about 15 g of liquid sodium caused a short circuit between the central heating wire and the braided metal sheath, as required for leak detection. The leak detector is suitable for use up to at least 565°C, but not as high as 750°C. (auth)

27535 (ANL/HFEF-3) FUEL-ELEMENT PROFILOMETER FOR THE HFEF. Carnes, M. D.; Gill, K. G. (Argonne National Lab., Ill.). Jul 1973. Contract W-31-109-eng-38. 30p. Dep. NTIS $3.50.

A remotely operable direct-contact gaging unit was built to measure the diameter of irradiated EBR-II fuel elements. The unit is an electronic gage using linear-voltage differential transformers as sensors. It produces a diameter profile by measuring diameter continuously over the element length. It can gage elements with or without spirally wrapped spacer wires, and is adjustable over a range of element diameters from 0.174 in. to 0.805 in. It is classed as a vertical unit because the element is maintained in a vertical position. Under in-cell operating conditions its uncertainty is less than ±0.0002 in. When it gages calibration standards that are round in cross section and straight, the uncertainty of the measurement is less than ±0.0001 in. (auth)

27536 (BNWL-1751(Pt. 2), pp 55) MINICOMPUTER APPLICATIONS IN INSTRUMENTAL ANALYSIS PROCEDURES. Kosorok, J. R. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The data transfer channel for transfer of spectra from the memories of multichannel analyzers to a computer is briefly described. (WHK)

27537 (BNWL-1751(Pt.2), pp 75-77) AEROSOL GENERATOR SYSTEM FOR SEQUENTIAL INERT TRACER RELEASE. Thomas, C. W.; Rieck, H. G. Jr.; Young, J. A.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

An aerosol generator system developed for the sequential release of up to 12 different tracers into storm systems to study several time dependent storm processes is briefly described. The generator system consists of two banks of four Brad-Patton aerosol generators mounted beneath and to the rear of the engine nacelles of the Battelle Cessna-411 aircraft. The generators release submicron-sized particles of the tracers by burning acetone-hexane solutions containing the elements. (WHK)

27538 (IFVE-SEF-72-9) SCALER WITH MAKING UP FOR COUNTING LOSS DUE TO THE DEAD TIME WITHOUT PROLONGING THE TIME OF MEASUREMENTS. Rodnov, Yu. V.; Sytin, A. N. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 10p. (In Russian). INIS.

A scaler with compensation for the dead time loss of the shaper without prolonging the measurement time is described. The device was developed in integral modules with dynamic indication of the decade in digital gas-discharge tubes. The counting characteristics of the device are reported. (tr-auth)

27539 (KFK-1719) CAMAC SINGLE CRATE CONTROLLER FOR PDP-8/E TYPE LEM-52/32.1. Hellmann, G.; Ottes, J. G. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jul 1973. 26p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

For many small CAMAC systems (one crate) to be operated by minicomputers, the typical configuration with crate controller type A-1 and the system controller is more complex and expensive than would be required. Therefore, a CAMAC single crate controller was developed as a crate controller that directly interfaces the dataway to the omnibus of a PDP-8/E computer. The module provides single word programmed transfers and block transfers, one channel is provided for single-cycle direct memory access transfers with the submodes "Add data to memory" and "Add one to memory". Interleaved programmed and DMA transfers are permitted. In programmed operations the Controller has a full 24-bit data transfer capability. The 12-bit word length of autonomous transfers has been extended to 24 bits for the submode "Add one to memory", that enables the PDP-8/E to act as pulse height analyzer. Twenty-four signals are connected through an OR-gate to the interrupt request line: the 22 LAM signals from the modules of which any one may also be used as trigger signal for an autonomous transfer, a signal indicating "End of block" for block transfers, and the overflow of a word counter in the controller during autonomous transfers of data. The demand handling subsystem has a built-in priority order and gives fast access to the appropriate interrupt processing routine on application of one special command. (auth)

27540 (LA-UR-73-1300) NANOSECOND PHOTOGRAPHY OF RADIACHROMIC PROCESSES. Berzin, G. J.; Han, K. S.; Lieber, A. J.; McGurn, J. S. (Los Alamos Scientific Lab., N. Mex.). 1973. 18p. (CONF-730930-1). Dep. NTIS $3.00.

From Electro-Optical systems design conference; New York, New York, USA (18 Sep 1973).

Techniques involving radiolysis of water have recently generated new interest in intense x-ray or electron pulse measurements. Such techniques offer time resolution which is superior to that attainable with scintillators, and are useful over several decades of radiation intensity. The interaction of ionizing radiation with aqueous solutions produces "solvated" or "hydrated" electrons. The ability of these electrons to absorb visible and near infrared photons results in the important characteristic of radiachromism. Thus one can monitor the transmission of light through a sample subjected to a radiation burst and deduce information about the radiation field from modulation of the intensity. Transmitted light intensity is typically monitored by a photodiode or a photomultiplier and the signal is recorded on an oscilloscope to provide an intensity vs time record. The data recording has been extended to include two spatial dimensions as well as time by using a fast framing camera. A series of photographs yields data with more than 10^4 picture elements per frame, and time resolution approaching a nanosecond. (WHK)

27541 (SGAE-2138) PROPOSAL FOR A CAMAC MULTI-CRATE SERIAL TRANSMISSION SYSTEM. Buschbeck, F.; Neuwirth, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Elektronikinstitut). May 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

A summary is given on necessary requirements for synchronization of serially transmitted information. The known synchronization methods are reviewed, regarding the transmission of CAMAC messages. A new, unique synchronization method for CAMAC signals is proposed and described in detail. (auth)

27542 (SGAE-2144) CAMAC: DIGITALER MULTIPLEXER. Schwabach, H.; Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH., Seibersdorf. Elektronikinstitut). Jun 1973. 19p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A CAMAC module for the data acquisition of 24 bit input data is described. An external multiplexer unit, which can be controlled by the 16 subaddresses, can extend the application of the module for the acquisition up to 384 input signals. (auth)

27543 (SLA-73-586) POST MORTEM OF THE CABLE AND CONNECTOR SYMPOSIUM. Traeger, R. K. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 15p. Dep. NTIS $3.00.

A cable-connector symposium brought together over 80 individuals representing the AEC weapon agencies. Discussions were presented on shielding, testing, flat cables and fabrication. Abstracts of the individual papers are included for future reference and critiques of the conference by the attendees are summarized. The symposium met its goals of improving communication and should probably be repeated every two years. (auth)

27544 METHOD AND DEVICE FOR THE SERVOCONTROL OF THE POSITION OF ION BEAMS IN A MASS SPECTROMETER. Bir, R.; Boyer, R. (to Commissariat a l'Energie Atomique). French Patent 2,147,496. 29 Jul 1971. 8p. (In French).

A method and a device for the position servocontrol of ion beams in mass spectrometers is presented. The device was designed for measuring the ratio between the number of ^{235}U ions and ^{238}U ions in UF^{5+} ions obtained by the electron bombardment of uranium hexafluoride using the double collection method. Two plate form deflector electrodes supplied with a dc voltage obtained with a variable potentiometer are positioned on either side of the pilot beam parallel to the pilot collector slit and slightly ahead of the collector. The servounit incorporates 4 amplifiers. The manual adjustment of the potentiometer enables the distance to be varied between the pilot beam and the measurement beams. (FR)

27545 METHODS OF PULSED NEUTRON WELL-LOGGING. Bobrowski, C. (Instytut Techniki Jadrowej, Krakow). Tech. Poszukiwan; 11: 1-6(1972). (In Polish).

The physical bases for pulsed neutron techniques in well logging are discussed. Methods of interpreting measured results are briefly described. (auth)

27546 CURVE CRYSTALS FOR NEUTRON MONOCHROMATORS. Egert, G.; Dachs, H. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 32-34(1973). (In German).

It is shown that curved crystals can be used as neutron monochromators in order to optimize resolution and intensity. The production and properties of these curved crystal monochromators are described. (GE)

27547 TRANSMISSION OF INFORMATION FROM PULSE HEIGHT ANALYZER TO THE "URAL-11B" ELECTRONIC COMPUTER. Barakovskii, I. D.; Zapevalov, V. A.; Yavorovskii, V. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 146-150(1972). (In Russian).

A system is described for transmitting information accumulated in a multichannel pulse amplitude analyzer to the electronic computer URAL-11B where the information is further processed. The algorithms used and diagrams of the control systems are shown. (KSW)

27548 FAST-NEUTRON COLLIMATOR FOR THE MEASUREMENT OF INELASTIC SCATTERING BY NUCLEI. Myachkova, S. A.; Nefedov, V. V.; Shtranikh, I. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 107-111(1972). (In Russian).

The question of lowering the background in fast neutron experiments was examined. A collimating shield with annular geometry was constructed for measuring the scattering of 14-MeV neutrons by atomic nuclei. The angular distribution of neutrons scattered by carbon from 30 to 150° was measured. The neutron scattering equipment included a scintillation spectrometer. Scattering experiments with and without the collimator showed that for energies >5 MeV the collimator improved the results by a factor of four, irrespective of a pronounced distortion in the spectrum of incident neutrons. (tr-auth)

27549 RADIATION-CHEMICAL CONSTRUCTION OF INSTRUMENTS: THE PRINCIPLES FOR THE ESTABLISHMENT OF MATERIAL-TECHNICAL BASIS OF APPLIED RADIATION CHEMISTRY. Breger, A. Kh.; Gol'din, V. A.; Dobrovol'skii, S. P.; Kozlov, Yu. D. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 312-322(1973). (In Russian).

A review with 127 references devoted to the principal goals and current status in the area of radiation-chemical construction of instruments—one of the more important components of radiation-chemical technology—is given. The review covers experimental and design results of the construction of radiation-chemical instruments using: (1) γ-irradiation of long lived radioisotopes (^{60}Co) as well as of the short lived ones in nuclear power reactors (complex energy-chemical use of nuclear fuel) and (2) electron streams generated by the accelerators. Areas have been pointed out in which the potential of the utilization of various radiation sources was the highest, considering both the radiation-technological parameters of these processes and their economic indicators. The state of the art satisfies the requirements originating in the realization of these results in agriculture. (JPRS)

27550 ULTRASONIC VOID FRACTION DETECTOR. Arave, A. E. (to United States Atomic Energy Commission). U. S. Patent 3,744,301. 10 Jul 1973. Filed date 9 Sep 1971. 6p.

The attenuation of an ultrasonic tone burst propagated in a wire is measured to determine the void fraction of a gas-liquid mixture. When the gas-liquid mixture consists of a layer of gas over a liquid, the void fraction detector can be used as a liquid level indicator. (Official Gazette)

27551 PULSE PROCESSING SYSTEM. Fasching, G. E.; Patton, G. H. (to United States Atomic Energy Commission). U. S. Patent 3,747,001. 17 Jul 1973. Filed date 17 Feb 1972. 8p.

A pulse counting system with improved energy resolution is disclosed having dual channels for pulse processing at different rates and a pulse pileup detector to select which channel is utilized. Pulse input is delayed until the pileup detector can determine if any pulse is so closely followed in time by a second pulse to constitute pulse pileup. If no pulse pileup is detected, the slower channel is selected. The slow channel clips the pulse to a relatively wide pulse width to retain good energy resolution. If pulse pileup is predicted, the fast channel with correspondingly shorter pulse width is selected to improve resolution in respect to time. The output of the two channels is transmitted to a pulse height analyzer for interpretation. (Official Gazette)

27552 JUELICH GAS FILLED SEPARATOR JOSEF. Lawin, H. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The fabrication and properties of the Juelich on-line separator for fission products are described. The apparatus uses a 312° sector field, where the magnetic field region is filled to a pressure of several torr with He. (GE)

27553 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETRY. Powers, P. (to Associated Electrical Industries Ltd.). British Patent 1,318,400. 31 May 1973. Filed date 28 Aug 1970. 10p.

The object of the instrument described is to provide an apparatus that affords in a single beam system the main analytical capabilities of a multiple beam system, by time division multiplexing of a number of ion beams to form a single beam, and utilizing the mass spectrometer output to provide data representing analyses of the beams and hence of the substance being examined. The means for multiplexing may be such that individual peaks in the mass spectrometer output are each sampled several times. A digitized computer is employed in the analysis, and the means for multiplexing utilizes electrostatic fields for ion beam deflection. (UK)

27554 CAMAC IN DENMARK. Christensen, P. (Danish Association for Industrial Development of Atomic Energy, Hellerup); Hoey-Christensen, P.; Munkoee, L. CAMAC Bull.; No. 7, 11-12(Jul 1973).

The CAMAC activities in four Danish institutes are described, i.e., lifetime measurements in ^{239}U; control instrumentation for a triple axis neutron spectrometer; airborne γ-scintillometer installed in an aircraft and used in the search of uranium; and 5 parameter pulse height analysis system used in a fission experiment at the reactor DR3. (DE)

27555 NEW ELECTRONICS FOR RADIATION MEASURING IN AEC-NIM TECHNIQUE FOR MEASUREMENTS WITH 1-26 CHANNELS. Hoetzel, H.; Lang, B. (Siemens A. G., Karlsruhe, Ger.). Siemens-Z.; 47: No. 6, 476-477(1973). (In German).

During the past years, the module system AEC-NIM-Norm (AEC-NIM Atomic Energy Commission-Nuclear Instrument Modules) has been internationally accepted in electronics for radiation measuring. It is the most suitable for the use with various radiation measurements in nuclear technology and flexibility, and compatibility of the measuring equipment. (GE)

27556 HIGH RESOLUTION FOCUSSING "DIPOLE" MASS SPECTROMETER. Dawson, P. H. (Univ. Laval, Quebec). J. Mass Spectrom. Ion Phys.; 12: No. 1, 53-65(Aug 1973).

A high-resolution focussing "dipole' mass spectrometer is proposed and its properties are explored by the computer calculation of ion trajectories. The device has a field corresponding to half that of a quadrupole mass filter and consists of two hyperbolic rods and a plane grounded electrode. Low energy ions are injected transversely to the instrument axis. It is shown that by using the focusing properties of quadrupole fields, both a high resolution and a large mass range should be possible while preserving the usual advantages of quadrupole mass spectrometers. (auth)

27557 EFFECT OF ENTRY CONDITIONS ON ION TRANSMISSION IN A QUADRUPOLE FIELD. Nagarajan, R.; Ghosh, P. K. (Indian Inst. of Tech., Kanpur). J. Mass Spectrom. Ion Phys.; 12: No. 1, 79-85(Aug 1973).

Maximum amplitudes of ion trajectories in a two-dimensional quadrupole field have been computed by numerical integration of Mathieu's equation. The range of initial conditions, such as initial displacement of ions, phase at entry and radial velocity at entry, are those encountered in practical mass spectrometer operations. These computations have been carried out for a and q values along various mass scan lines in the range of $m/\Delta m$ = 70 to 1000. The bounds on the initial displacement of ions and radial velocity at entry are calculated for 100% ion transmission through the field. It is found that the bounds on the initial displacement and radial velocity are higher when both of them are non-zero than when either of them is zero indicating that the interaction effects cause higher bounds than those predicted by individual effects. (auth)

27558 MODULATED, PROGRAMMABLE MASS SPECTROMETER FOR ION BOMBARDMENT STUDIES. Zwangobani, E.; MacDonald, R. J. (Australian National Univ., Canberra). J. Phys., E (London); 6: No. 9, 925-929(Sep 1973).

A modulated mass spectrometer for use in ion bombardment work such as sputtering and radiation damage is presented. The instrument incorporates an oscillating electron beam ionizer of simple geometry but high ionization and extraction efficiencies. Advantages offered are widely variable resolution, versatility in application and high sensitivity. (auth)

27559 CIRCUITS OPERATING WITH A VARIABLE DC POTENTIAL FOR CONTROL AND WARNING PURPOSES. Gilleux, R. French Patent 2,139,765. 4 Jun 1971. 6p. (In French).

This circuit functioning with the variable dc voltage generated by a fire detector incorporating an analyzing ionization chamber is presented. It is suitable for triggering an alarm signal. A special feature is that the analyzing ionization chamber is supplied with a planar electrode provided with a radiation source; the electrode is implanted in an insulating support. Outside of the ionization chamber, the support extends as a tubular cavity in which a capacitor acting as a calibration reference is housed. The temperature correcting circuit consists of a transistor connected in series to a series of diodes, and a bias resistance which determines the triggering threshold of a monostable triggering circuit. (FR)

27560 LEAK DETECTING INSTRUMENTS. Smith, A. W. (to United Kingdom Atomic Energy Authority). British Patent 1,323,076. 11 Jul 1973. Filed date 23 Oct 1969. 2p.

An electrical leak detecting device for liquid alkali metal containing apparatus is described. Two conductors, spaced apart by insulating or semi-conducting material, are connected to a means for sensing changes in electrical conductivity of the circuit, a leakage of alkali metal from the apparatus into contact with the insulating material decreases the resistance between the conductors. Al may be used for the conductors, spaced apart by Al_2O_3 coatings. In one construction, anodised Al wires are arranged to form a mesh. Alternatively, the conductors comprise an anodised Al wire wound or laid on an anodised Al sheet. Both conductors may also consist of anodised Al expanded sheet. The anodic coatings form the isolating material. In use the devices are located below the Na circuit, so that in the event of leakage Na will fall and contact the Al_2O_3 coatings causing their corrosion and decreasing resistance. In a further construction the anodised Al wires are wrapped about a liquid Na conducting pipe, and in yet another construction a single anodised Al conductor is wrapped around a liquid sodium conducting pipe that forms the second conductor, spaced from the Al conductor merely by the anodic coating. Leakage containing jackets may be provided. (UK)

27561 TRIAL TO FIND AN OPTIMUM DESIGN OF A COAXIAL CIRCULAR APERTURE COLLIMATOR FOR THE MEASUREMENTS OF SPACE NUCLEAR RADIATION. Takeuchi, H. (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 2, 47-56(Jun 1973).

The so-called geometric factor of the collimator system in the isotropic radiation field is calculated analytically. Numerical results are given in the form of graphs and tables. It is shown that an appropriately tapered system has a larger value of the geometric factor and hence better counting statistics compared with those obtained by the cylindrical system with no taper, under the condition of keeping the detector size and the aperture angle constant. For instance, the increment of the geometric factor amounts to a factor of about two, where the ratio of the aperture diameters, characterizing the taper of the system, is three under the condition mentioned. Taking this fact into consideration, the graphs are useful for synoptic design studies of a collimator system under various requirements caused by the limit of space in a small sounding rocket or satellite. (auth)

27562 FLUORPHLOGOPITE SINGLE CRYSTAL AS A LONGWAVE NEUTRON MONOCHROMATOR. Zelenyuk, F. M.; Zaitsev, K. N.; Timakov, A. V.; Anikin, I. N.; Matveev, S. I.; Zhitarev, V. E.; Stepanov, S. V. (Moscow Engineering Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 399-401 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 57-59(1973).

The neutron-diffraction and time-of-flight methods were used to investigate the properties of fluorphlogopite crystals used as a longwave monochromator. The neutron diffraction patterns are given for reflection from the 001 phase at a temperature 293°K for fluorphlogopite having various isomorphic substitutions. The dependence of the reflection intensity on the thickness of the single crystal was investigated. The reflectivity of the fluorphlogopite for λ = 11.4 Å was equal to (24 ± 2)%. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

27563 (LA-UR-73-1258) STABLE ISOTOPES (ICONS) RESEARCH AND DEVELOPMENT PROGRAM AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Matwiyoff, N. A.; Reisfeld, M. J.; Mills, T. R.; McInteer, B. B.; Goldblatt, M. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 20p. (CONF-731010-1; SM-176/19). Dep. NTIS $3.00.

The Los Alamos Scientific Laboratory research program on stable isotopes is discussed. The present status of stable isotopes with regard to production, chemical synthesis, and analytical instrumentation is reviewed. The potential utility of these isotopes is illustrated with a few examples. (LCL)

27564 (NIIAR-P-141) THEORETICAL STUDY OF A CYLINDRICAL SURFACE IONIZER. Kalygin, V. V.; Prokop'ev, V. M. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 23p. (In Russian). INIS.

A theoretical investigation was made of the possibility of using a cylindrical surface ionizer in the ion source of an isotope mass separator. Its basic behavior was obtained in analytical form. The theoretical possibility of attaining high efficiency for the generation of ions with the use of a cylindrical surface ionizer and the suitability of its use in the ion source of an isotope mass separator for the separation of isotopes of elements with low surface ionization coefficients were shown. The criteria for the escape of ions without collisions with the walls of the ionizer were found. The effect of charge exchange and recombination of ions on the efficiency was evaluated. In the framework of the kinetic theory of gases, the problem of the determination of the regularity of the movement of the molecules in the ionizer of finite length was solved. The functions for the molecular current and the efficiency were found in dimensionless form and partially analyzed. It was shown that complete calculation of the cylindrical ionizer can be carried out on the EVM. (tr-auth)

27565 URANIUM ENRICHMENT IN THE EUROPEAN COMMUNITY. Centrifugal Method Provides High Flexibility. Braatz, U. Handelsblatt; 28: No. 99, 22(1973). (In German).

Nuclear energy which up to the present has only played a very small part in supplying the electricity demand, is being used increasingly for the generation of electricity. Its share in 1980 is already expected to be some 25% and even 60 to 70% by 1990. This means that by 1980 a capacity of about 70,000 MWe will be installed and of about 150,000 MWe by 1990 in the European Community nuclear power plants. (GE)

27566 FLEXIBLE COLLECTOR SYSTEM FOR ISOL EXPERIMENTS. Alpsten, M.; Appelquist, A.; Bengtsson, B.; Borgentun, E.; Johansson, K. A.; Jonson, B.; Nyman, G. (Chalmers Univ. of Tech., Goteborg). Nucl. Instrum. Methods; 111: No. 3, 431-434(1973).

A collector system constructed for use with an on-line isotope separator is described. The system is based on transportation of separate backings for collection of activity and subsequent measurement. It represents an alternative to moving tape systems and offers advantages in certain respects. (auth)

27567 SHAPE OF PIERCE ELECTRODES FOR DIVERGENT WEDGE-SHAPED BEAMS. Sar-el, H. Z.; Chavet, I.; Kanter, M. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 111: No. 3, 613-614(1973).

The correct shape of the Pierce electrodes for space charge compensation of a divergent wedge beam has been calculated following the method developed by Radley. This beam shape is most frequently used in electromagnetic isotope separators. (auth)

Isotopic Power Sources

Refer also to abstracts 27155 and 27157.

27568 (IESD-2873-172) SNAP 19 PIONEER F AND G FINAL REPORT. (Teledyne Isotopes, Timonium, Md. (USA). Energy Systems Div.). Jun 1973. 150p. Dep. NTIS $7.60.

The generator developed for the Pioneer mission evolved from the SNAP 19 RTG's launched aboard the NIMBUS III spacecraft. In order to satisfy the power requirements and environment of earth-escape trajectory, significant modifications were made to the thermoelectric converter, heat source, and structural configuration. Specifically, a TAGS-2N thermoelectric couple was designed to provide higher efficiency and improved long-term power performance, and the electrical circuitry was modified to yield very low magnetic field from current flow in the RTG. A new heat source was employed to satisfy operational requirements and its integration with the generator required alteration to the method of providing support to the fuel capsule. Data are presented on the mission and spacecraft requirements; design of all RTG components, including heat source, thermoelectric generator, housing, instrumentation, etc.; RTG operating characteristics; performance testing of RTG; design modifications affecting inert cover gas management and fuel capsule mechanical constraints; nuclear safety analysis; and auxiliary ground equipment. (LCL)

27569 (MLM-2080) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: APRIL–JUNE 1973. (Mound Lab., Miamisburg, Ohio). 7 Sep 1973. Contract AT(33-1)-Gen-53. 57p. Dep. NTIS $5.45.

Progress in the isotopic fuels program during Apr. to July 1973 is reported. Preparation and process studies of ^{238}Pu fuels continued. Sufficient fuel was processed to fabricate two Viking capsules containing a total of 1364.21 W of plutonium-238. Seventeen pressed plutonium oxide spheres were fabricated as part of the MHW (Multihundred Watt) fuel development effort. Six spheres were used for substoichiometric studies. Vacuum reduction of PuO_2 MHW fuel was considered. The degree of high-temperature vacuum reduction of $^{238}PuO_2$ MHW fuel spheres was experimentally determined over the 1400 to 1800°C range. The one-hour 1400°C treatment did not result in a measurable change in the O/Pu ratio. However, one hour at 1550°C resulted in an observable reduction in the O/Pu ratio to <2.000 (approx. 1.996). Increasing the duration of the 1550°C treatment to 5 h gave only a slight but further reduction to approximately 1.994. To obtain reductions on the order of O/Pu ≤1.98, temperatures of 1700 to 1800°C for 1 h were necessary. All PPO spheres heated to ≤1700°C fractured after one or two heat cycles. For spheres reduced to O/Pu ≤1.98, monitoring of the neutron emission rate appears to offer a promising method to detect reoxidation. A gamma spectroscopic method for determining the ratios of Pu isotopes relative to ^{239}Pu contained in nuclear materials was developed. A computer program for preparing tables of actinide valence state distributions is presented. In the process studies, a vacuum hot press, capable of exerting 20,000 psi on a specimen heated to 2300°C in a chamber evacuated to 10^{-3} torr, was placed in operation, and a mist eliminator which removes 99% of all particles 3 μm or less in size has reduced the need for absolute filter changes from twice weekly to three times annually. (LCL)

27570 (ORNL-TM-4243) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1973. Fraas, A. P.; Samuels, G. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Work in progress on developing a 1 to 10 kW radioisotope-fueled energy conversion system for terrestrial and undersea use is described. Information is included on: facilities for decomposition testing of materials being evaluated as a working fluid for an organic Rankine cycle conversion system; decomposition test results which indicated that the gas volume evolved in capsules loaded with Dowtherm A was much higher than for capsules containing material produced by the Eastman Kodak Co.; performance testing of heat pipes for a thermoelectric system; full-scale testing of fusible insulation; and thermal and impact testing of fuel capsules. (LCL)

Radiation Sources

Refer also to abstract 27939.

27571 USE OF HEAVY METALS IN NEUTRON HOWITZERS. Cox, A. J.; Jarallah, M. A. Int. J. Appl. Radiat. Isotop.; 24: No. 9, 550-551(Sep 1973).

When paraffin wax is used as the moderator in a Thermal Neutron Howitzer a limitation in the performance occurs due to the absorption of neutrons by the hydrogen and other elements in the wax. Investigations are reported on the incorporation of heavy metals such as iron into the paraffin wax to produce a rapid slowing down of the fast neutrons from the isotopic source by inelastic scattering and by reduction of the number of collisions necessary to thermalize them. Absorption is thereby reduced and a greater yield obtained. Paraffin wax is retained to provide the elastic scattering necessary to increase the neutron yield in

the required direction. The results of measurements with an optimum configuration are given. These are compared to the best results obtained previously for a paraffin wax howitzer and which had already attained a four-fold increase in thermal neutron yield compared to an isotropic paraffin wax moderator. It is seen that on average the thermal neutron yield is increased by a further factor of 14. (UK)

27572 LEAK TESTING RADIOACTIVE BRACHYTHERAPY SOURCES. New York; American National Standards Institute (1972). 11p. (ANSI-N44.2).

This standard provides guidelines for testing the leakage of sealed, radioactive brachytherapy sources. Seal integrity of these sources shall be maintained to prevent loss of radioactive material and thus assure effective radiation output; prevent unnecessary radiation exposure and contamination of patients and medical personnel; and prevent local or widespread radioactive contamination and the resultant costly decontamination operations and liability damage. (auth)

27573 INTEGRITY STANDARDS AND TEST SPECIFICATIONS FOR SELECTED BRACHYTHERAPY SOURCES. New York; American National Standards Institute (1972). 20p. (ANSI-N44.1).

This standard establishes the integrity requirements and test specifications for selected, sealed brachytherapy sources. The particular standards and specifications required are those which are appropriate to the various types of sources being considered. The standard does not attempt to establish design requirements but rather establishes performance standards for the particular sources involved, such that any sources which pass these tests shall be expected to be acceptable for use in brachytherapy. (auth)

27574 NEUTRON SPECTRA OF ^{241}Am/B, ^{241}Am/Be, ^{241}Am/F, ^{242}Cm/Be, ^{238}Pu/^{13}C, AND ^{252}Cf ISOTOPIC NEUTRON SOURCES. Lorch, E. A. (Radiochemical Centre Ltd., Amersham, Eng.). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 585-591(Oct 1973).

Neutron spectra from ^{241}Am/B, ^{241}Am/Be, ^{241}Am/F, ^{242}Cm/Be, ^{238}Pu/^{13}C, and ^{252}Cf isotopic neutron sources have been measured using a spectrometer employing a thin stilbene crystal. The ^{242}Cm/Be spectrum shows marked differences from that of ^{241}Am/Be. The spectrum from ^{241}Am/F shows fine structure not previously reported elsewhere. Differences between the spectra published here and the results of other workers are attributed to both differences in source and spectrometer designs. (auth)

27575 NEUTRON SPECTRUM OF Am–Be NEUTRON SOURCES. Vajaya, A. D.; Kumar, A. (Bhabha Atomic Research Centre, Trombay). Nucl. Instrum. Methods; 111: No. 3, 435-440(1973).

Neutron spectra of ^{241}Am-^{9}Be(α,n) sources have been calculated by using the most recent data on angular distributions. The contribution from the multibody break-up reaction ^{9}Be(α,αn)^{8}Be has also been incorporated by using the measured angular distributions of this reaction at various energies. Modifications to the spectrum due to the secondary interactions in the source such as elastic scattering with beryllium, oxygen, and americium, and the ^{9}Be(n,2n) and ^{241}Am(n,f) reaction have been investigated by means of Monte Carlo and other quadratures, as earlier calculations were uncertain below 2.5 MeV. The neutron spectrum of a 1 Ci ^{241}Am-^{9}Be source was measured with nuclear emulsions. Comparison of the spectra obtained by other methods with the present measurement shows little discrepancy among the measured spectra, except that the 0.3 MeV peak is not observed in the emulsion measurements. The present calculations show that inclusion of secondary interactions does not account completely for the increased intensity in the lower end of the spectrum. These interactions account for the variation of the spectrum with the size and beryllium content of the source. (auth)

Design and Fabrication

27576 IONIZATION DEVICE FOR A FRANKLIN POINT. Massot, D. P. French Patent 2,131,074. 31 Mar 1971. 6p. (In French).

An easily demountable device for a Franklin point is presented that can be used in conjunction with any existing lightning conductor. The device is constructed such that the ionization sources can be easily replaced without danger. The device is provided with several rigid rods which are fixed to a liner capable of sliding over the point or being fixed to it. The rods are distributed at various azimuthal angles with respect to the point. The ends of these rods are designed to accommodate an ionization source, these sources being contained in a source-holder provided with classical means for its fixation and disassembly (screw or bayonet fitting). (FR)

27577 ORGANIC, RADIOISOTOPE-CONTAINING, CARBONACEOUS MATRIX HEATED IN INERT ATMOSPHERE. Lahr, T. N.; Volkmann, R. E. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,746,650. 17 Jul 1973. Filed date 26 Feb 1970. 8p.

A method is reported for the production of radioactive sources of the type wherein the radioactive material is firmly and nonleachably bound within fired particles, each of these particles providing a matrix for the nonleachable retention of the radioactive material. The radioactive source preferably is obtained by heating a particulate ion exchange resin, containing one or more radioisotopes ion-exchanged therein, in an oxygen-free atmosphere. The resulting heat-treated particles contain the radioisotopes nonleachably bound in a carbonaceous matrix. The heat-treated particles have good chemical and physical integrity and a low inorganic ash content. (JGB)

Industrial Uses

Refer also to abstracts 27273, 27601, 27602, and 27647–27650.

27578 (DP-MS-71-52) APPLICATIONS OF TRANSPLUTONIUM ELEMENTS. Crandall, J. L. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab). 21 Sep 1973. 31p. (CONF-711078-2). Dep. NTIS $3.75.

From 3rd international transplutonium element symposium; Argonne, Illinois, USA (20 Oct 1971).

The cost and application of ^{238}Pu, ^{242}Cm, ^{244}Cm, ^{241}Am, and ^{252}Cf as radiation sources are discussed. (TFD)

27579 ELECTROMAGNETIC MIXING EFFECT ON SOLID METAL SOLUTIONS IN LIQUIDS STUDIED WITH THE USE OF RADIOISOTOPE CONTROL SYSTEM. Dubodelov, V. I.; Polishchuk, V. P.; Markovskii, E. A.; Kochegura, N. M.; Kazachkov, S. P. (Inst. of Foundry Problems, Kiev). Inzh.-Fiz. Zh.; 24: No. 6, 1002-1009(Jun 1973). (In Russian).

Experimental data are presented that was obtained from investigations of additive solutions and kinetics of mass transfer during production of lead and aluminum alloys. A radioisotope method is described which provides direct information on the processes proceeding directly in liquid phase. (auth)

27580 DETERMINATION OF THE SIZE DISTRIBUTION OF AEROSOLS WITH THE HELP OF A RADIOACTIVE TRACER AND THE SPIRAL CENTRIFUGE. Porstendoerfer, J. (Inst. fuer Biophysiks, Giessen, Ger.). J. Aerosol Sci.; 4: No. 5, 345-354 (Sep 1973). (In German).

A method for measurement of size distributions of unknown aerosols is described. ^{220}Rn decay products were attached to particles and the radioactive aerosol was deposited in a spiral centrifuge. By measuring the distribution of activity along the brass foil of the spiral centrifuge, the relative size distribution of the aerosol was determined. After calibration with nearly monodisperse latex spheres, the size distributions of cigarette smoke, the particulate phase of motor car exhaust gas, and the atmospheric aerosol were determined. (auth)

27581 SURFACE STATES AND TRANSFORMATIONS. Technical Meeting, Paris, France, Jun 7, 1971. Paris; Compagnie Francaise d'Editions (1972). 265p. (In French).

Fifty papers were presented at this meeting. A separate abstract was prepared for each of four papers. One paper was previously abstracted in NSA. For an abstract of the paper see 27: 03074. (FR)

For abstracts of individual papers see: 26962, 27527, 27582, and 27583.

27582 STUDY OF SOLID SAMPLES WITH SMALL SURFACE AREAS BY THE PHYSICAL ADSORPTION OF RADIOACTIVE KRYPTON. Beurton, G.; Bussiere, P. (CNRS, Villeurbanne, France). pp 11-13 of Surface States and Transformations. Paris; Compagnie Francaise d'Editions (1972). (In French).

From technical meeting on surface states and transformations; Paris, France (7 Jun 1971).

Krypton-85 can be used to measure very small areas and to determine the energy characteristics of surfaces. The techniques employed are described. (FR)

27583 MEASUREMENT OF RESIDUAL GREASE CONTAMINATION. Fiaud, C. (Centre d'Etudes et de Recherches des Etats de Surface, Paris); Jacob, M. pp 87-91 of Surface States and Transformations. Paris; Compagnie Francaise d'Editions (1972). (In French).

From technical meeting on surface states and transformations; Paris, France (7 Jun 1971).

Methods (used in space industry, nuclear industry, etc.) for

directly controlling the physical cleanness of surfaces are presented, i.e., workshop methods (destructive and nondestructive); laboratory methods (gravimetry, fluorescence, and radioactive tracers). (FR)

27584 PROBE FOR ESTIMATING THE CHARACTERISTICS OF SUBSURFACE OR GROUND WATER FLOW. Abdullaev, A. A.; Shutova, A. (to Institut Yadernoi Fiziki Akademii Nauk Uzbekskoi SSR). British Patent 1,321,740. 27 Jun 1973. Filed date 26 Nov 1971. 4p.

Disadvantages of conventional radioisotopic probes are stated. The improved probe described comprises a cylindrical shield, made of material opaque to the kind of radiation employed, with gas-discharge counters spaced equidistantly around its outer surface, and pulse registering means separately connectable to each counter. The shield is solid, with longitudinal slots in its outer surface for location of the counters. The pulse registering means comprises a cathode follower associated with each counter, and connected by a multi-core cable to a ground based counter scaler or radiometer. The shield and counters may be housed in a common casing. (UK)

27585 PROBE FOR ESTIMATING THE CHARACTERISTICS OF SUBSURFACE OR GROUND WATER FLOW. Abdullaev, A. A. (to Institut Yadernoi Fiziki Akademii Nauk Uzbekskoi SSR). British Patent 1,321,739. 27 Jun 1973. Filed date 25 Nov 1971. 4p.

An improved probe is described for estimating the characteristics of high velocity flows of subsurface and ground waters, with the aid of radioisotopes. It consists of a hollow cylindrical shield, made of material opaque to the kind of radiation employed, with gas-discharge counters spaced equidistantly around its outer surface. The shield has open longitudinal grooves between the counters, and pulse registering means are provided separately connectable to each counter. Means are provided for releasing radioisotopes within the shield, these being carried by the subsurface or ground water flow through the open grooves to act upon the counters. The pulse registering means may comprise a cathode follower, associated with each counter, and connected by a multi-core cable to a ground based counter scaler or radiometer. The radioisotopes may be contained within a water-soluble shell located within the shield. Iodine-131 is a suitable radioisotope. The shield and counters may be housed in a common casing. (UK)

27586 FORMULATION OF RADIATION CURABLE PAINTS. Garratt, P. G. (INRESCOR AG, Schwarzenback, Switzerland). J. Oil Colour Chem. Ass.; 56: No. 6, 266-273(Jun 1973).

The radiation curing of paints offers a process whereby coatings can be cured at an extremely fast rate and solvent-free paints can be used. In order to gain these advantages, however, much tighter restrictions are imposed on the paint formulation than with conventional hardenable paints. The desired application, hardening, and film characteristics must all be achieved by suitable formulation of the paint itself. This paper attempts to review some of the problems involved in the formulation of such paints and to illustrate the reasons why resins and formulations must be "tailor made" for this particular application. (auth)

27587 OBSERVATIONS ON TRANSPORT PROCESSES IN HALOGEN LAMPS. Bartha, L.; Hangos, T. (Kozponti Fizikai Kutato Intezet, Budapest). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 605-608(Oct 1973).

The W-transport process was investigated in halogen lamp models using ^{185}W isotope. The ideal operating conditions are described. The kinetics of the process in different lamp models was determined. (auth)

27588 NONDESTRUCTIVE DETERMINATION OF THE INSIDE WALL TEMPERATURE OF HALOGEN LAMPS. Bartha, L.; Hangos, I. (Kozponti Fizikai Kutato Intezet, Budapest). Int. J. Appl. Radiat. Isotop.; 24: No. 10, 609-610(Oct 1973).

To measure the temperature of the inner surface of a closed system without disturbance of the system, a method has been developed which is based on the measurement of the surface diffusion from a radioactive source deposited on the surface whose temperature is required. For the method to be applicable, the transport of the tracer atoms must be due only to surface diffusion and not due to evaporation or recondensation and also the tracer must be a radioactive isotope either of one of the components of the system or it should behave neutrally. An application of the method is the measurement of the temperature of the inside wall of a halogen lamp using KCl labelled with ^{42}K as the diffusing source. Data are given which are in fair agreement with former calculations. (UK)

27589 APPLICATION OF RADIOISOTOPES FOR WEAR MEASUREMENT OF MOTOR COMPONENTS. Oblaender, K.; Friedlein, J. Motortech. Z.; 34: No. 7, 211-215(1973). (In German).

The isotope method for wear measurements makes it possible to obtain fast comprehensive information and to save time and development costs in programs for testing machine parts. Examples of application from the Daimler-Benz AG motor test on connecting rod bearings and on camshafts using the through-flow method and thin layer difference method are described. (GE)

27590 APPLICATIONS OF RADIOISOTOPES IN METALLURGY. Dara, S. S.; Misra, V. N. (Visvesvaraya Regional Coll. of Engineering, Nagpur, India). J. Sci. Ind. Res.; 29: No. 9, 403-413 (Sep 1970).

Applications of radioisotopes as tracers in metallurgy are reported. The method of activation in different metallurgical specimens is discussed. Recently developed tracer techniques such as differential radioactive tracer techniques, radio release techniques, non-active tracer methods, etc. are described in detail. The extensive uses of isotopes in diffusion studies such as sintering of metal powders, chromizing and carburizing homogenization of casting and forging, and phase changes and transformations are mentioned. The basic techniques for diffusion studies such as the sectioning technique, surface counting, and autoradiography are also described. Industrial applications of diffusion studies, flaw detection, blast furnace practice, steel making and other important physical and extractive metallurgical problems are discussed. (INIS)

LIFE SCIENCES

27591 (AED-CONF-71-400, pp 271-278) ELECTRON LINACS IN RADIOBIOLOGICAL RESEARCH. Kiefer, J. (Univ., Giessen, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The principles of biological radiation effects are summarized and special problems are discussed that can be solved by the use of electron linacs (pulse radiolysis, maximum dose rate irradiation, irradiation with variable repetition frequency). The application of electron linacs offers particular advantages in the study of physico-chemical primary processes following radiation absorption in the cell. (GE)

Radiation Effects on Biochemicals

27592 (BNWL-1751(Pt.2), pp 85-87) BIOLOGICAL DAMAGE CAUSED BY RADIATION-INDUCED RADICALS. Kalkwarf, D. R.; Felix, W. D. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

An evaluation is made of the abilities of radiation-induced free radicals to propagate and amplify biochemical damage initiated by low doses of ionizing radiation. It involves determination of the type and the concentration of radicals formed under various conditions and the assessment of their chemical reactivities with critically important cellular components. (auth)

27593 SPECIFIC PHOTOREACTION IN POLYDEOXY-ADENYLIC ACID. Poerschke, D. (Max-Planck-Institut fuer Biophysikalische Chemie, Goettingen, Ger.). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 9, 2683-2686 (Sep 1973).

Ultraviolet photosensitivity of the single-stranded forms of poly(A) and poly(dA) is compared. In contrast to poly(A), poly(dA) is rather sensitive to ultraviolet irradiation. Relatively low doses of ultraviolet light lead to characteristic changes of the ultraviolet and circular dichroism spectra of poly(dA), suggesting formation of a specific photoproduct in poly(dA) that cannot be formed in poly(A). The quantum yields in poly(dA) ($\phi = 2.5 \times 10^{-3}$) are about a factor of 10 higher than in poly(A), indicating a high structure specificity. The base-pairing capacity of irradiated probes of poly(dA) to poly(dT) is inhibited. These results demonstrate a relatively high probability of DNA photolesions, that cannot be repaired by simple repair enzyme systems. (auth)

Radiation Effects on Cells

Refer also to abstracts 27626 and 29481.

27594 (BNWL-1751(Pt.2), pp 97-98) HIT THEORY FOR LOW-LET RADIATION. Roesch, W. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The mathematical formulations of the hit theory for the biological effects of low-LET radiation have been improved to permit the following generalization: whereas last year it had to be assumed that the probability of two hits interacting to produce cell death decreased exponentially with the time between them, now, any functional form for the decrease in probability can be admitted. The assumption of exponential time dependence was given firmer justification by showing under what circumstances it followed from another model, for although it enters the hit theory as an assumption, it cannot be derived from that theory. In this model molecules that were activated by the radiation were assumed to disappear at random at a constant rate and to cause death either by the effects of one of them alone or by the effects produced by pairs. (CH)

27595 (BNWL-1751(Pt.2), pp 98-100) EXPERIMENTAL DOSIMETRY: PROTON AND ELECTRON BEAM IRRADIATION OF CELLS GROWING IN MONOLAYERS. Braby, L. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

To minimize the radiation variables in biological experiments, direct beam irradiation of cells growing in a monolayer were used. Both proton irradiation and electron irradiation will be employed to compare the repair mechanisms, oxygen effect, and cell cycle sensitivity variations at different LETs. Major problems are discussed. (CH)

27596 TRANSMUTATION VERSUS BETA IRRADIATION IN THE PATHOLOGICAL EFFECTS OF TRITIUM DECAY. Feinendegen, L. E. (Nuclear Research Center, Juelich, Ger.); Bond, V. P. pp 221-231 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritium decays in a single step to ^3He and emits a β particle with maximum energy of 18.6 keV and a maximum range of about 6 μm in water. The reactions involved in the transmutation of tritium are reviewed in relation to biological effects produced by tritium incorporated in cells. Data are reviewed from a number of studies on the biological effects from tritium incorporated into DNA or RNA of bacteria, Drosophila, or cultured mammalian cells. It was concluded that tritium transmutation effects have been demonstrated when cells are maintained at low temperatures that inhibit normal repair processes. However, tritium decay within the DNA molecule of cells under normal growth conditions does not cause any observable effects in addition to those from β particles. (24 references) (CH)

27597 INACTIVATION OF CULTURED HUMAN CELLS AND CONTROL OF C3H MOUSE MAMMARY TUMORS WITH ACCELERATED NITROGEN IONS. Brown, D. Q.; Seydel, H. G.; Todd, P. (American Oncologic Hospital, Philadelphia). Cancer; 32: No. 3, 541-546 (Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

Accelerated nitrogen ions (N^{7+}) from the Princeton Particle Accelerator were used to irradiate three dimensional cultures of human kidney T-1 cells and 2 mm thick transplanted C3H mouse mammary tumors. Cell survival was determined at the Bragg peak and at the entrance portion (plateau) of the beam using colony formation as the survival criterion. Resulting cell survival curves were compared with those for x-irradiation under hypoxic and aerobic conditions. The mammary tumors were given single N^{7+} fractions of 690, 1400, 2800, and 5500 rads in the Bragg peak. The resulting tumor cure dose for 50% of the animals (TCD_{50}-120) was determined to be 2400 rads as compared with 5100 rads with x rays. The relative biological effectiveness (RBE) decreased with increasing dose in both systems and ranged between 1.5 and 4.5 for aerobic human cells, 3.7 and 12 for hypoxic human cells, 0.96 and 1.6 for acute mouse skin reaction, 1.9 and 2.5 for mouse tumor control. The RBE for tumor control was consistent with that for hypoxic cells. These results appear to support the proposed use of heavy ions in radiotherapy, at least in cases of small, localized tumors, although further study is needed to determine their effectiveness in the treatment of large volumes, which would require irradiation with multiple Bragg peaks. (auth)

27598 ENHANCEMENT OF THE RADIATION RESPONSE OF CULTURED TUMOR CELLS BY CHLOROQUINE. Kim, S. H. (Memorial Hospital, New York); Kim, J. H.; Fried, J. AT(11-1)-3521. Cancer; 32: No. 3, 536-540 (Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

The treatment of tumor cells in culture with chloroquine after irradiation significantly reduces their survival, but no enhancement is seen when the cells are treated with the drug before irradiation. This suggests that the potentiation of the radiation response by chloroquine results from the impairment of the post-irradiation recovery processes. Incorporation studies with melanotic melanoma cells in culture derived from human malignant melanoma demonstrate significantly higher uptake of the compound than in amelanotic melanoma, HeLa, or nonpigmented human diploid cells in culture. The significance of these findings is discussed in relation to the potential use of the drug as a radiosensitizer in selected human tumors. (auth)

27599 MORPHOLOGICALLY DIFFERENTIATED MOUSE NEUROBLASTOMA CELLS INDUCED BY NONCYCLIC AMP AGENTS: LEVELS OF CYCLIC AMP, NUCLEIC ACID, AND PROTEIN. Prasad, K. N.; Gilmer, K.; Kumar, S. (Univ. of Colorado, Denver). Proc. Soc. Exp. Biol. Med.; 143: No. 4, 1168-1171 (Sep 1973).

The levels of cyclic AMP, DNA, RNA, and protein were measured in morphologically differentiated cells induced by noncyclic AMP agents such as 5-bromodeoxyuridine (5-BrdU), 6-thioguanine, serum-free medium (SFM) and x rays. The cyclic AMP levels in

5-BrdU-, SFM-treated cells increased by about twofold, whereas it remained unchanged in x irradiated and 6-thioguanine-treated cells. This shows that x ray and 6-thioguanine probably bypass the step involving the elevation of cyclic AMP. Sodium butyrate increased the cyclic AMP level without causing morphological differentiation, indicating that an elevation of cyclic AMP is not sufficient for the expression of differentiated phenotype. The RNA and protein contents of differentiated cells markedly increased. The DNA content of SFM- and 6-thioguanine-treated cells did not significantly change when compared to controls, indicating that the relative distribution of cells throughout the cell cycle was about the same as controls. The DNA content of 5-BrdU treated cells markedly decreased, indicating that most of the cells were accumulated in the G_1 phase. The DNA content of x irradiated cells markedly increased, indicating that the expression of differentiated phenotype occurred in the G_1 phase and/or in the polyploid cells. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 27647–27650.

27600 (BNWL-1751(Pt.2), pp 93-94) MECHANISMS OF ENVIRONMENTAL EXPOSURE. Endres, G. W. R.; Shipler, D. B. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Since the shutdown of the plutonium production reactors in January of 1971, the only radioisotope associated with the operation of the Hanford plant which can now be detected in environmental residents is ^{65}Zn. As a consequence, studies on the mechanisms of environmental exposure have centered around measurements of this nuclide in man and have emphasized in particular the determination of improved values for parameters relating to human uptake and retention of ^{65}Zn. Several whole body counter examinations were conducted and data were obtained on several hundred local students who had been similarly examined during May 1971, March 1972, May 1972 and December 1972. After the reactors were shut down, it was expected that the source of radioactive ^{65}Zn in the local food chain and drinking water would no longer exist; therefore, several replicate surveys were conducted over a two-year period in an attempt to determine the effective half-life for ^{65}Zn in the human population. The survey results are presented. (auth)

27601 (TID-26437) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN DOGS. Final Report. (Food and Drug Research Labs., Inc., Maspeth, N. Y. (USA)). 5 Jan 1971. Contract AT(30-1)-3734. 299p. Dep. NTIS $17.00.

In accordance with the provisions of AEC Contract No. AT(30-1)3734, chronic (2-yr) feeding studies in dogs were conducted with diets containing 35% (dry basis) of dehydrated banana powder. This material was obtained by freeze drying ripe (stage 6) bananas that were previously subjected to ionizing radiation (Cobalt-60) in the green state. Three semi-purified diets were employed representing fruit that had received, respectively, none, 20 kilorads, and 40 kilorads of gamma radiation. The performance of dogs that were fed these banana diets was compared with that of comparable animals fed a commercial dog food (Purina Dog Chow). Appearance, behavior, growth, maturation, reproductive performance, biochemical, and hematological parameters were monitored periodically throughout the study. Postmortem examinations of all dogs that died or were sacrificed included organ weights, gross and microscopic pathology. All observations conducted in the course of this study were consistent with the conclusion that gamma radiation of green bananas induced no toxic or deleterious effects that could be demonstrated by feeding the freeze-dehydrated pulp of the ripened fruit to beagle dogs at the 35% dietary level. (auth)

27602 (TID-26438) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN RATS. Final Report. (Food and Drug Research Labs., Inc., Maspeth, N. Y. (USA)). 5 Jan 1970. Contract AT(30-1)-3734. 289p. Dep. NTIS $16.00.

Chronic (2-yr) feeding studies in rats were conducted with diets containing 35% (dry basis) of dehydrated banana powder. This material was obtained by freeze-drying ripe (stage 6) bananas that were subjected to ionizing radiation in the green state. Three banana diets were employed representing fruit that had received none, 20, and 40 kilorads of gamma radiation from a cobalt-60 source. The performance of the rats fed banana diets was compared with that of a comparable group that received a commercial diet (Purina Laboratory Chow) with respect to growth, efficiency of food utilizations, maturation, reproductive performance (through 3 descendant generations), and hematological and biochemical parameters. Postmortem examination of all rats that died or were sacrificed at intervals throughout the study included organ weights, gross and microscopic pathology. Special attention was paid to the occurrence of tumors. All observations completed in the course of the study were consistent with the conclusion that the gamma irradiation of the green banana had no effect on the nutritive values of the dehydrated pulp nor were any deleterious properties conferred on the fruit that adversely affected the animals fed the powder. Details of the procedures employed and the results obtained are contained in the attached report. (auth)

27603 TEMPERATURE-SENSITIVE MUTANTS OF HERPES SIMPLEX VIRUS TYPE 1: ISOLATION, COMPLEMENTATION, AND PARTIAL CHARACTERIZATION. Schaffer, P. A.; Aron, G. M.; Biswal, N.; Benyesh-Melnick, M. (Baylor Univ., Houston, TX). Virology; 52: No. 1, 57-71(Mar 1973).

Twenty-two temperature-sensitive mutants of herpes simplex virus type 1 isolated following mutagenesis with 5-bromodeoxyuridine, nitrosoguanidine, and ultraviolet light were classified according to their ability to complement each other at 39°C, the nonpermissive temperature. Fifteen nonoverlapping complementation groups were identified. Partial biochemical characterization of mutants demonstrated that members of four groups were unable to synthesize viral DNA at 39°C. Several mutants were found to differ from the wild-type virus with regard to thermal stability at 39°C, suggesting that they may possess altered structural proteins. (auth)

27604 RESPONSE OF PHAGE T5 TO HOST CELL REACTIVATION. Godsell, A. M.; Clarke, C. H. (Univ. of East Anglia, Norwich, Eng.). Virology; 52: No. 1, 310-313(Mar 1973).

The response of uv-irradiated bacteriophage T5 to host cell reactivation was studied. It was found that there are two types of phage T5 in use. The one designated T5A is not susceptible to host cell reactivation. The other, designated T5B, is susceptible to host cell reactivation. (ERB)

Radiation Effects on Plants

Refer also to abstract 27687.

27605 (BNWL-1751(Pt.2), pp 108-110) CELL IRRADIATION IN A MONOENERGETIC PROTON BEAM. Braby, L. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Synchronized Chlamydomonas reinhardtii cells on agar in 30 torr of air saturated with water vapor were irradiated with 1.55 MeV monoenergetic protons. The beam at the location of the cells was uniform to within 10% over an area 0.5 cm in diameter. The dose rate, approximately 10 krad/sec, was calculated from the proton fluence which was measured with a Faraday cup. Each dose was monitored by counting scattered protons with a solid-state detector in a fixed position outside the beam. Survival curves showed a pronounced shoulder followed by what appeared to be a continuous curvature rather than the straight line expected for exponential survival. This finding suggests that proton irradiation inactivates by multiple energy deposition events. Furthermore, at the LD 50, 5000 rads, the fluence was about 16 protons per μm^2; the nuclear cross-section at the time of irradiation was approximately 3 μm^2. If the whole nucleus is the target, these data are consistent with multiple-hit inactivation. The RBE at the LD 50 level relative to 300 kVp x rays was about 2. (CH)

Radiation Effects on Animals

Refer also to abstract 27061.

Man

Refer also to abstracts 27202, 27572, 27573, 27598, 27641, 27664, and 29105.

27606 (AD-753209) EFFECTS OF CENTRAL NERVOUS SYSTEM IRRADIATION ON HUMAN PERFORMANCE, BLOOD PRESSURE, AND EMOTIONAL STATE. Final Report. Wolfgang, A.; Maier, J. G. (Walter Reed General Hospital, Washington, D. C. (USA)). Dec 1972. 41p. (DNA-2935-F). NTIS.

The overall aim of this study was to assess changes in human performance as a result of various combinations of dose, time,

and volume of central nervous system irradiation. Twenty-eight separate behavioral measures ranging from blood pressure, motor coordination, and muscle strength, to memory, motivation, anxiety, and decision-making ability were obtained. Overall, the results showed that relatively young healthy subjects receiving central nervous system irradiation involving the spinal cord or brain for extracranial neoplasms showed no performance decrement when compared to the matched controls on a broad range of behavioral functions. Even the extreme cases receiving the highest dose and volume of ionizing irradiation showed no apparent performance decrement. The only objective measure that was significant was blood pressure where a decline was found particularly in diastolic blood pressure from the pre-exposure to post-treatment trials. (auth)

27607 (CONF-710501-P1, pp 37-52) ENVIRONMENTAL ASPECTS OF NATURAL GAS STIMULATION EXPERIMENTS WITH NUCLEAR DEVICES. Anspaugh, L. R.; Koranda, J. J.; Robison, W. L. (Univ. of California, Livermore). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

It is likely that future activities administered by the USAEC Division of Peaceful Nuclear Explosives will be in the area of underground engineering. and particularly in the stimulation of deeply buried natural gas reservoirs of low permeability. The successful development of this technology could double the proved recoverable resources of natural gas in the United States. During the developmental stage of the technology, large quantities of THO are released to the environment as the gas is withdrawn. Efforts to predict potential doses resulting from such releases have been severely handicapped by the lack of adequate data to predict the ecological movement of THO. A radioecological study was conducted in conjunction with Project Rulison, the second nuclear-stimulation experiment, to evaluate these parameters; controlled laboratory studies were also initiated. The results indicate that the environmental residence time of THO is at least an order of magnitude shorter than has been frequently assumed, and that this invalidates the commonly used deposition velocity approach for the calculation of doses due to food chain contamination by THO vapor. A simple but realistic model is developed based on these findings to predict the dose to man via the forage-cow-milk, forage-cattle-beef, vegetation, and inhalation pathways. The dose predicted by this model for the Rulison area residents is 10^3 to 10^4 lower than the preflaring estimates made by a variety of organizations. Within the limits of the environmental data, the dose of 3×10^{-6} rem predicted from the model for the Rulison high-rate production flaring is verified as an upper limit. These results are extrapolated to predict the dose to man if a field of nuclear-stimulated natural gas wells were to supply a 1000-MW(e) power station. The dose via all pathways would be an order of magnitude lower than the dose via inhalation alone if the same natural gas were to replace the natural gas supply delivered to the Los Angeles Basin or San Francisco Bay Area. (auth)

27608 (CONF-710501-P1, pp 53-62) YEAR 2000: NUCLEAR POWER AND MAN. Strauch, S. (Atomic Energy Commission, Washington, DC) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The extent of the nuclear power industry in the United States in the year 2000 and its radiological impact on man at that time is considered. The AEC initiated a study in January 1970 to develop a computer model and necessary data to permit estimates of potential doses and dose commitments to individuals and population groups as a result of selected release rates from reactors and fuel reprocessing plants in a large geographic region. The model is of the sophistication warranted for 30 years forecasting purposes and of sufficient generality and scope to permit it to eventually encompass the contiguous United States. The model is being applied initially to the Upper Mississippi River Basin for the nuclear facilities which are projected to be located in that region by the year 2000. Exceptional care is being taken to ensure that all radionuclides and their associated pathways that lead to significant doses are included in this initial development phase of the model. (MCG)

27609 (DHEW-73-8038) BUREAU OF RADIOLOGICAL HEALTH RESEARCH GRANTS PROGRAMS, FISCAL YEAR 1972. Boeker, E. H.; O'Connell, T. J. (eds.) (Bureau of Radiological Health, Rockville, MD). May 1973. 201p. GPO.

Research grant activities from July 1, 1969 to June 30, 1972 described in this publication are funded by the Bureau of Radiological Health, Food and Drug Administration, and administered by the Bureau's Program Office. The aim of research grants is to support the Bureau's efforts to promote the health of man by reducing the hazards from radiation, both ionizing and nonionizing. Information about individual projects was obtained from summary statements prepared by the principal investigators to define their objectives and describe significant results. Project publications that could be identified as grant supported are listed for the duration of the grant. Research grants are listed. An index includes an alphabetical listing of principal investigators, grantee institutions, and geographical locations, a grouping of grants by DHEW regions and information about the 10 regional offices. (auth)

27610 (NP-19845) SURVEY OF RADIATION PROTECTION COURSES IN THE SIX COUNTRIES OF THE EUROPEAN COMMUNITIES. (European Communities, Luxembourg. Commission). 1972. 118p. (In Several Languages). Dep. NTIS (U. S. Sales Only) $8.00.

On the occasion of a discussion concerning the instruction and training of workers in radiation protection organized by the Commission in December 1969 in Brussels, in which there participated, besides those responsible for radiation protection in the member countries of the Community, specialists in training subjects, occupational psychologists, specialists in ergonomics, representatives of authorities responsible for inspection, and also representatives of company partners, the wish was expressed regarding the possibility of preparing a document summarizing the facilities for radiation protection training existing in the countries of the Community. This booklet constitutes an initial examination of the documents that are available to the Commission. It indicates in the language of origin and for each country the courses for radiation protection organized by the various institutions and specifies in brief: the subject matter of the courses; the practical exercises; the duration; the possible examination on the completion of study; and also the conditions of entry. This list does not contain internal radiation protection courses organized by nuclear research centres and by industry and designed normally in dependence on the particular features of the work places in question. (auth)

27611 (ORNL-TM-4294) CALCULATIONS RELATED TO THE APPLICATION OF NEGATIVELY CHARGED PIONS IN RADIOTHERAPY: ABSORBED DOSE, LET SPECTRA, AND CELL SURVIVAL. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 90p. Dep. NTIS $6.50.

Calculations using a Monte Carlo radiation transport code and a model for cell inactivation were carried out to estimate the spatial distributions of the absorbed dose, LET spectra, and the cell survival, RBE, and OER for T-1 human kidney cells produced by a beam of negatively charged pions incident on a slab of tissue. (auth)

27612 POST-RADIATION PERICHONDRITIS AND CARTILAGE NECROSIS OF THE LARYNX. McGovern, F. H.; Fitz-Hugh, J. S.; Constable, W. (Univ. of Virginia, Charlottesville). Laryngoscope; 83: 808-815(May 1973).

From meeting of the southern section of the American Laryngological, Rhinological, and Otological Society, Inc.; Washington, DC (13 Jan 1973).

Under certain circumstances laryngeal cartilage damage following radiation therapy can take place. Two cases of post-radiation perichondritis with cartilage necrosis are reported, and the factors predisposing to its development, the methods of treatment, and the techniques of radiation therapy are discussed. The danger of repeated intralaryngeal manipulation in the radiation patient is stressed. It is advised that T_1N_0 and T_2N_0 laryngeal lesion be treated with 6,000 rads over a three to five-week period. Homogeneity is achieved in the treated volume by employing wedged filters. Surgery is advised in T_3 or larger lesions usually after preoperative cobalt radiation. (auth)

27613 BIOLOGICAL BASIS OF RADIATION PROTECTION. pp 14-37 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The early knowledge of the effects of radiation on man is reviewed and the present knowledge of these effects is briefly summarized. Delayed radiation effects, somatic effects, and genetic effects of ionizing radiations following external and internal exposure are discussed. (ERB)

27614 ULCERATIVE RADIATION DERMATITIS; SECONDARY TO RADON SEEDS. Auerbach, R.; Pearlstein, H. H. N. Y. State J. Med.; 73: No. 17, 2183-2184(1 Sep 1973).

A case report is given of ulcerative dermatitis of the face in a 47-yr old man who had been treated 25 yrs earlier with radon seed implants. The ulcers were treated with surgery, and histopathologic examinations revealed acute and chronic inflammation and necrotic skin with no evidence of malignancy. A discussion is presented of the decay of ^{222}Rn; the half-life of ^{210}Pb is 22 yrs. Radia-

tion damage to the skin is discussed and the malignant potentiality of radiation dermatitis is emphasized. (HLW)

27615 LUNG FUNCTION AFTER MANTLE FIELD IRRADIATION IN HODGKIN'S DISEASE. Hoest, H. (Norwegian Radium Hospital, Oslo); Vale, J. R. Cancer; 32: No. 2, 328-332 (Aug 1973).

Seventeen patients with extrathoracic Hodgkin's disease were treated with mantle field irradiation and repeatedly observed with regard to their ventilatory function for 9 to 23 months after the completion of radiotherapy. Twelve of them also underwent thorough studies of pulmonary gas exchange. The vital capacity was reduced on the average by about 10% shortly after the treatment. A corresponding reduction of the total lung capacity persisted and, at the end of the study, was partly due to a decrease of the residual volume as well. The irradiation had no apparent influence on the pulmonary gas exchange as judged from arterial blood gas tensions, alveolar-arterial oxygen difference, and dead space for CO_2 determined at rest and during moderate exercise. The low level of restrictive ventilatory impairment and the absence of gas exchange disturbances are ascribed to effective shielding of the pulmonary parenchyma, leaving but marginal lung regions and extrapulmonary thoracic structures exposed to irradiation. (auth)

27616 EFFECT OF RADIATION THERAPY ON MUMPS-DELAYED TYPE HYPERSENSITIVITY REACTION IN LYMPHOMA AND CARCINOMA PATIENTS. Check, J. H.; Damsker, J. I.; Brady, L. W.; O'Neill, E. A. (Hahnemann Medical Coll. and Hospital, Philadelphia). Cancer; 32: No. 3, 580-584 (Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

A study was undertaken to see the effect of radiation therapy on delayed type hypersensitivity reactions to mumps skin test antigen in patients with Hodgkin's disease, non-Hodgkin's lymphomas, carcinomas of the cervix, and carcinomas in which the thymus received direct irradiation. When compared to post irradiation patients with carcinoma of the cervix, the results showed a marked decrease in skin reactivity in post-irradiation patients with Hodgkin's disease and carcinomas such as breast, esophagus, and lung in which the thymus was irradiated. Non-Hodgkin's lymphoma patients also showed a decrease in skin reactivity, but not to the same degree as in Hodgkin's patients. It was found that of the non-Hodgkin's lymphoma patients, only those who did not receive thymic irradiation reacted positively to the mumps antigen. The results indicate that irradiation of the thymus may play an important role in persisting anergy in post-treatment Hodgkin's patients who are in clinical remission. (auth)

27617 GROWTH RETARDATION IN CHILDREN AFTER MEGAVOLTAGE IRRADIATION OF THE SPINE. Probert, J. C. (Stanford Univ., CA); Parker, B. R.; Kaplan, H. S. Cancer; 32: No. 3, 634-639 (Sep 1973).

From proceedings of the annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

Twenty-two children, under the age of 15, received complete spinal irradiation with a linear accelerator, for treatment of lymphoma, medulloblastoma, and acute lymphoblastic leukemia. Sixteen of the 22 children show retardation of growth of the spine. Ten children have a sitting height, which is a reflection of spinal length, more than two standard deviations from the normal mean for their age. Children receiving irradiation at the times of most active growth, under the age of 6 and at the time of puberty, show especially marked retardation of spinal growth. (auth)

27618 IN VITRO CHROMOSOMAL RADIOSENSITIVITY IN CHROMOSOMAL BREAKAGE SYNDROMES. Higurashi, M. (Tokyo Univ.); Conen, P. E. Cancer; 32: No. 2, 380-383 (Aug 1973).

Peripheral blood samples from 11 children with the chromosomal breakage syndromes, ataxia-telangiectasia, Bloom's syndrome, and Fanconi's anemia, and from 4 normal children were irradiated with 10 and 100 rads. Non-irradiated duplicate cultures were used to determine the pre-irradiation breakage. All cultures were harvested at 52 hours. Radiation-break frequencies were calculated by subtracting figures for non-irradiated samples from those for irradiated samples. The number of chromosome-type breaks per cell per rad was: 0.0017 ± 0.0012 in controls, in ataxia-telagiectasia 0.0062 ± 0.0019, in Bloom's syndrome 0.0061 ± 0.0019, and in Fanconi's anemia 0.0085 ± 0.0023. The number of dicentrics and rings per cell after 100 rads was significantly greater in samples from chromosomal breakage syndromes than in controls. We concluded that, in vitro, chromosomes of cells from children with chromosomal breakage syndromes were significantly more radiosensitive than those of controls. (auth)

27619 RADIATION PNEUMONITIS: A NEW APPROACH TO THE DERIVATION OF TIME–DOSE FACTORS. Wara, W. M.; Phillips, T. L.; Margolis, L. W.; Smith, V. (Univ. of California, San Francisco). Cancer; 32: No. 3, 547-552 (Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

A series of 51 patients treated with 92 separate lung fields for metastatic pulmonary disease between 1958 and 1971 is reviewed. The treatment data are converted into nominal single doses (NSD) and a newly derived formula for estimated single doses (ED). The 5% incidence level of pneumonitis without dactinomycin is 770 rets (NSD) and 510 rets (ED) and with dactinomycin, 520 rets (NSD) and 450 rets (ED). A safe treatment regimen for avoiding radiation pneumonitis is 1500 rads in 10 fractions with dactinomycin and 2500 rads in 20 fractions without dactinomycin. (auth)

27620 RADIATION PROTECTION OF THE CORNEA AND LENS DURING PETROUS-BONE TOMOGRAPHY. Dobrin, R.; Becker, M. H.; Genieser, N. B. (New York Univ., N. Y.). Radiology; 109: No. 1, 201-204 (Oct 1972).

Exposure to the cornea during petrous-bone tomography was studied as a function of the thickness of lead eye shields. Image quality was studied as a function of the shield thickness and the distance between the shield and the plane of interest. A difference of less than 3% was found between the protection afforded by 0.27 and 2.71 mm of lead. Minimal deterioration in film quality was seen with increasing lead thickness. The primary cause of a loss of detail was the presence of the hypocycloidal overlay pattern, which may vary in intensity with minor changes in patient positioning. (auth)

27621 ESTIMATION OF BENEFIT AND RADIATION RISK FROM MASS CHEST RADIOGRAPHY. Kitabatake, T.; Yokoyama, M.; Sakka, M.; Koga, S. (Niigata Univ., Japan). Radiology; 109: No. 1, 37-40 (Oct 1973).

The benefits and radiation risks are estimated from a mass chest x-ray survey in present-day Japan. About $4{,}000 \times 10^4$ chest fluorographies were carried out in 1968: 44,447 cases of active pulmonary tuberculosis and a probable total of 758 curable cases of lung cancer were detected. However, 1.82 leukemias per year or about 46 leukemias and 7 incurable chest cancers in the forthcoming 25-year period are expected among this population. Also, 150 genetic deaths are estimated until the 10th generation. (auth)

Vertebrates

Refer also to abstract 27597.

27622 (CEA-N-1619) RADIOPROTECTIVE ACTION OF SEROTONIN ON THE SECONDARY EFFECTS OF γ IRRADIATION ON THE ULTRASTRUCTURE OF THE DIAPHRAGM MUSCLE OF THE RAT. Ibrahim, H. A. E. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1973. 10p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The radioprotective effect of serotonin was studied in the rat by comparing batches of rats irradiated at 1000 rads with batches protected by serotonin and irradiated at the same dose. In the rats given serotonin, no injury was observed in their diaphragms fixated by perfusion on the 4th day, whereas damage of the sarcolemma and dilatation of the sarcoplasmic reticulum was noticed in the irradiated unprotected rats. (FR)

27623 (CEA-N-1630) STUDY OF THE ULTRASTRUCTURE OF THE RAT DIAPHRAGM FOLLOWING WHOLE-BODY γ-RAY EXPOSURE OF 12,000 RADS. Thiery, G.; Ibrahim, H. A. E. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Male rats were exposed to whole-body irradiation at 12,000 rads. Fixation of their diaphragms was performed by perfusion with a solution of glutaraldehyde just at the end of the exposure. The only damage shown by an ultrastructure study of the muscle was a change of the cellulary lipido-metallic complexes. The membrane and mitochondria lesions usually described seemed only secondary as compared with the disequilibrium of the cell metallic complexes. (FR)

27624 (CONF-710501-P1, pp 579-584) ACUTE AND CHRONIC IRRADIATION EFFECTS IN MOSQUITO FISH AT 15 OR 25°C. Cosgrove, C. E.; Blaylock, B. G. (Oak Ridge National Lab., TN) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Mosquito fish (Gambusia affinis) were irradiated (^{60}Co gamma rays) and maintained at either 15 or 25°C. Acute irradiation doses ranged from 750 to 6000 rads. Chronic irradiation was at dose rates of 1.3, 2.5, or 5.4 rads/hr for periods of up to 47 days. In

the acute study, mortality exceeded control values only at 5800 to 6000 rads. At these doses, none of the fish survived beyond 13 days at 25°C and none beyond 26 days at 15°C. In the chronic study, mortality never exceeded control values, although doses of over 5000 rads were accumulated by some fish. Acute irradiation produced atrophy in the hemopoietic organs (head, kidney, and spleen), with severity proportional to dose. In most groups, fish maintained at 25°C were more quickly and severely affected than fish held at 15°C; the reverse was true for females in the lower dose groups. The same relations between dose and temperature were seen for ovarian damage. Testis atrophy accompanied all doses in both acute and chronic studies. Otherwise, fish in the chronic study did not show radiation damage. Epithelial damage was seen only in fish irradiated at 5800 to 6000 rads. (auth)

27625 (TID-26373) AN ATLAS OF RF MOUSE PATHOLOGY: DISEASE DESCRIPTIONS AND INCIDENCES. Clapp, N. K. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 125p. Dep. NTIS $5.45.

To provide baseline pathology data for future experiments, diseases found in an experimental population of 3135 female RF mice are reported and incidences of the diseases found in the untreated controls are included. Four types of leukemias (thymic lymphoma, myeloid leukemia, reticulum cell sarcoma, and nonthymic lymphoma) are described, with incidences in untreated mice of 4.0, 0.9, 56.2, and 7.0%, respectively. The most common primary sites for nonreticular tumors were lung (37.2%) and ovary (4.4%), with tumors of all other sites totaling 6.3%. Other diseases of the RF mouse include auricular thrombosis (6.8%), bronchopneumonia (9.4%), and polyarteritis (13.6%) in the 427-mouse subgroup. Incidences of other diseases in the 311-mouse subgroup were polyarteritis (18.0%), arterial hyalinization (14.1%), and glomerulosclerosis (slight, 26.7%; moderate, 31.8%; severe, 36.6%). In irradiated mice, glomerulosclerosis was seen in most kidneys beyond 30 days postirradiation, and was a noninflammatory deposition of eosinophilic material in the mesangium of the glomerular tuft. Gross and histopathologic photographs are included to illustrate the diseases described. (auth)

27626 (TID-26446) AGE-RELATED CHANGES IN CELL-MEDIATED IMMUNE RESPONSIVENESS. Goodman, S. A. (Oak Ridge National Lab., Tenn.). Mar 1973. 153p. Dep. NTIS $9.75.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The immune surveillance hypothesis predicted that the effectiveness of a surveillance mechanism to remove spontaneously arising aberrant cells and expressed by the cell-mediated arm of the immune system declined with age, thereby allowing the increased proliferation of the aberrant cells and resulting in an increase in neoplastic disease. To test this hypothesis, studies were initiated to determine the effect of age on cell-mediated immune responsiveness in a long-lived mouse hybrid and a short-lived mouse strain and to determine the nature of any age-related changes which might be observed. Cell-mediated immune responsiveness was assessed by two criteria: the ability of $BC3F_1$ (the long-lived hybrid, $H\text{-}2^{bk}$) and AKR (the short-lived strain, $H\text{-}2^{k}$) spleen cells sensitized to allogeneic $CD2F_1$ ($H\text{-}2^{dd}$) histocompatibility antigens to kill target P815 mastocytoma cells bearing the same antigens ($H\text{-}2^{d}$) as the sensitizing cells in vitro and the resistance of unsensitized $BC3F_1$ mice to allogeneic tumors in situ. The former assay detected a maximum 4-fold difference in cytolytic activity between young (3-4 month) and old (27-32 month) $BC3F_1$ spleen cells based on dose-response analysis. Half of this decrease was shown to be the result of a 2-fold decrease in the frequency of functional immunocompetent units in old mice. The latter assay detected a 500-fold difference in the minimum number of P815 mastocytoma cells necessary to result in the death of an old (28-32 months) and a young (3-4 months) mouse. It was postulated that the cytolytic activity of spleen cells was not the limiting factor in the increased susceptibility of old mice to the tumors. Data show a decline in cell-mediated immune responsiveness with age in both long-lived and short-lived mice in agreement with the immune surveillance hypothesis. The decline in activity in AKR mice did not appear to occur before the onset of cancer was in contrast to what would be expected according to the hypothesis. (auth)

27627 INFLUENCE OF IRRADIATION ON TRITIUM INCORPORATION IN HAIR. Jaworowski, Z.; Bilkiewicz, J.; Radwan, I. (Central Lab. for Radiological Protection, Warsaw). pp 285-288 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The effects of exposure of rats to doses of 50 or 200 rad external x radiation on the uptake of tritium by hair following subcutaneous injection of doses of 4.5, 45, 450, or 2265 μCi/animal of tritiated water were studied. The amount of tritium incorporated in hair varied from 0.027 to 0.042% of the injected dose, with the internal dose ranging from 0.075 to 35.0 rem. Results indicated that exposure to x radiation on the day of tritium injection increased tritium uptake by hair as compared with nonirradiated controls. Lower tritium uptake by hair was observed following exposure of rats to 200 rad than to 50 rad x radiation. (CH)

27628 HEMOPOIETIC STEM CELL GROWTH AND MICRODIFFUSION. Matioli, G.; Merritt, M.; Vasudevan, R. (Univ. of Southern California, Los Angeles). Math. Biosci.; 17: No. 3-4, 339-355(Aug 1973).

Extensive experiments carried out to study the kinetics of stem cell growth in the spleen of irradiated mice are reported and the methods used are elaborated. The temporal and spatial features of the growth of the hypernetted, interacting system of stem cell chains in the spleen may be understood on the basis of a random distribution of source cells and of a microdiffusion stimulus for stem cell renewal along the cell chains. To test the validity of these assumptions, the growth kinetics are studied after administering various doses of colchicine to stem cells during different stages of growth. The behavior of the various phases of the recovery curves lends support to the theory of microdiffusion. Using the number of stem cells at saturation, the diffusion coefficient of the stimulus for renewal is approximately 10^{-7} cm^2 sec^{-1}. (auth)

27629 COMPARISON OF FRACTIONATED VERSUS SPLIT-COURSE IRRADIATION ON RENAL BLOOD FLOW IN MICE. Brown, R. C.; Glatstein, E. (Mount Vernon Hospital, Northwood, Eng.). Cancer; 32: No. 3, 524-527(Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

In clinical radiotherapy, the kidney is the organ within the upper abdomen most likely to limit the radiation dose. Since the parenchyma is a slow renewal system in terms of proliferation, the vascular network of the kidney has been suggested as the limiting factor. To investigate this possibility, ^{86}Rb extraction by the kidney of C_3H mice following intravenous injection was employed as a measure of blood flow to the kidney. The kidneys of C_3H mice were regionally irradiated according to the following fractionation schemes: single doses, three fractions per week for 3 weeks, and a split-course of five fractions in 4 days, followed by a 10-day gap and a repeat of five fractions in 4 days. The two dose levels for each fractionation schedule were calculated to be equivalent to 1000 and 2000 rets. Accordingly, the single doses were 1000 and 2000 rads. At 4 months, renal ^{86}Rb extraction was measured at the time of sacrifice of the animals. The data demonstrated that the effects of single doses could not be distinguished from those of the calculated numerically equivalent ret doses. In addition, there was not a significant difference demonstrated between the fractionated and split-course schedules. (auth)

27630 RADIATION AND ACTINOMYCIN D MORTALITY STUDIES IN C57BL/6 MICE. II. Combined Treatment and Gastrointestinal Lethality. Concannon, J. P.; Dalbow, M. H.; Hagemann, R. F.; Frich, J. C. Jr.; Hodgson, S. E.; Weil, C. S.; Martinelli, R. (Allegheny General Hospital, Pittsburgh). Cancer; 32: No. 3, 553-561(Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

C57BL/6 mice were treated with actinomycin or radiation therapy and with a combination of the two agents. LD50 estimates based on radiation doses were calculated from 6-day (intestinal death) mortality data. A factorial analysis of the data was performed to determine the main effects for actinomycin (A) or radiation exposure (R) as well as actinomycin-radiation (AR) interactions. The LD50 data indicated that the effects of the combined treatment were generally more lethal in causing intestinal death than the effects of either agent given independently. Significant main effects for A and R were generally observed with few AR interactions. The principal mechanism for intestinal death in animals treated with various combinations of actinomycin and radiation exposure appears to be additive cytotoxicty either at the level of crypt survival and/or prolongation of the time to the appearance of the compensatory proliferative response. (auth)

27631 ESTIMATION OF PREVALENCE RATES OF RADIOGENIC LEUKEMIAS IN RFM/U MICE. Elashoff, R. M.; Ludwig, F. C.; Hemphill, P. (Univ. of California, San Francisco). PSEBA; 143: No. 4, 1150-1152(Sep 1973).

Mice received a single whole-body dose of 300 rad x radiation. About 70 mice were killed at intervals of 20 days beginning 70 days after exposure. Histological and pathological examinations were made and at each of the days selected for sacrifice times, the number of leukemic mice in the sample was determined. The point prevalence rate was then obtained. Death from radiogenic

leukemias occurred not earlier than 3 months after irradiation and increased thereafter until the end of the 200-day period. The incidence was higher in the sequentially sacrificed animals than in spontaneously dying animals. During the period of 100 to 200 days there was a steady increase of the point prevalence rates. (HLW)

27632 RADIOPROTECTION OF TUMOR AND NORMAL TISSUES BY THIOPHOSPHATE COMPOUNDS. Phillips, T. L.; Kane, L.; Utley, J. F. (Univ. of California, San Francisco). Cancer; 32: No. 3, 528-535(Sep 1973).

From proceedings of the 14th annual meeting of the American Society of Therapeutic Radiologists; Phoenix, AZ (1 Nov 1972).

The efficacy of the radioprotective thiophosphate compounds WR638 (sodium hydrogen S-[2 aminoethyl] phosphorothioate) and WR2721 (S-2-[3-aminopropylamino] ethyl phosphorothioate) was determined for a wide range of normal tissue and tumor endpoints. Dose-modifying factors (D. M. F.) were obtained for mouse skin, small intestine, bone marrow, esophagus, lung, and kidney. D. M. F. values were also obtained for the P-388 leukemia, the EMT-6 mouse mammary carcinoma assayed in vitro, and the EMT-6 mammary carcinoma assayed for cure. The D. M. F. values obtained for normal tissue ranged from 1.2 for lung to 3 for bone marrow CFU's. The D. M. F. values for tumor ranged from 1.3 for cure of the EMT-6 carcinoma to 2.2 for mean survival time in the P-388 leukemia. There appears to be a decreasing dose-modifying factor as a function of increasing dose in both tumor and normal tissue systems. The degree of protection afforded tumors appears to relate to their vascularization and their anoxic cell component. Although the D. M. F. obtained for cure of the solid EMT-6 carcinoma would appear to be lower than for normal tissues with single doses, the data presently available do not allow one to predict that such a beneficial effect would occur with the multiple small doses used clinically. (auth)

27633 RADIATION PNEUMONITIS. Ultrastructural Changes in the Pulmonary Alveoli Following High Doses of Radiation. Madrazo, A.; Suzuki, Y.; Churg, J. (City Coll., New York). Arch. Pathol.; 96: No. 4, 262-268(Oct 1973).

Hamsters were given 10,000 rads of x-ray irradiation to the lungs and were studied by light and electron microscopy 48 hrs to seven weeks later. The principal changes were degeneration and regeneration of pulmonary cells, with little or no inflammation. The epithelial cells of the alveoli and the endothelial cells of the capillaries tended to separate from their basement membranes, with the latter becoming conspicuously wrinkled in a manner similar to that seen in radiation nephritis. The epithelial cells often exhibited features of both granular and membranous pneumonocytes and, occasionally, features of alveolar macrophages. Although changes observed in the radiated animals have been found also in other conditions, the combination of morphologic features here reported appears to be characteristic of the early stages of radiation pneumonitis. (auth)

Invertebrates

Refer also to abstract 27231.

27634 (CONF-710501-P1, pp 585-590) EFFECTS OF TEMPERATURE AND CHRONIC IRRADIATION ON POPULATIONS OF THE AQUATIC SNAIL PHYSA HETEROSTROPHA. Cooley, J. L. (Oak Ridge National Lab., TN) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Chronic gamma irradiation decreased the fecundity of the aquatic snail Physa heterostropha, while an elevated temperature increased its fecundity. Groups of known-age snails were exposed to dose rates of approximately 1, 2, and 5 rads/hr at 15 and 25°C in a 4 × 3 factorial experiment. At 25°C a reduction in fecundity was found at all three dose rates, while only the 5-rad/hr group showed reduced fecundity at 15°C. Egg hatching decreased significantly at 2 and 5 rads/hr at 15 and 25°C. Life span of adult snails was shortened significantly by all three doses at 15°C but only at 2 and 5 rads/hr at 25°C. Effects of chronic irradiation on snail populations were greater at 25°C because of the reduction in fecundity at all doses. Snails were significantly more fecund at 25°C than at 15°C. Elevated temperatures did not affect egg hatching. Elevated temperatures alone were not considered to be detrimental to snail populations under conditions of this laboratory experiment. (auth)

27635 EFFECTS OF A NUCLEAR DETONATION ON ARTHROPODS AT THE NEVADA TEST SITE. Allred, D. M. Brigham Young Univ. Sci. Bull., Biol. Ser.; 18: No. 4, 1-20 (Jul 1973).

Fifty-three arthropod species were studied in an area affected by an underground nuclear detonation (Sedan). These were represented by 10 species of ants, 17 beetles, 5 orthopterans, 4 scorpions, 6 solpugids, and 11 spiders. Relative populations were determined prior to the detonation and at three periods after the detonation— (1) one and two months after (August and September 1962), (2) 11 months after (June 1963), and (3) 13 months after (August 1963). One and two months after the detonation, the number of species was reduced from the expected by 48%, by 52% after 11 months, and by 66% after 13 months. Greatest reduction of specimens occurred with spiders, followed by ants and beetles. Fewest changes occurred in the number of scorpions. Populations of each group changed significantly in each period. Reductions from 30 to 100% occurred in all groups in all periods after the detonation except for the scorpions one and two months after, when an increase of 160% was noted. After 11 months spiders had increased 33%. Within specific sectors, populations did not vary significantly from the expected except in a few instances. In August and September 1962, immediately after the detonation, populations of arthropods in sectors 3, 4, and 5 were much higher than expected. This represented the area from approximately 65m to 140m from ground zero. The increase may have been due primarily to the physical transport and initial survival of those arthropods living closer to ground zero than 65m. Similarly, slight increases were noted in sectors 7 and 9, but these likely were not significant. In June 1963 in sector 5 and in August 1963 in sector 3, slight increases in populations were noted. These may have been due to seasonal differences correlated with vegetative type, and are also not considered significant. (auth)

27636 RESPONSE OF LABORATORY-REARED ADULT PLUM CURCULIOS TO ULTRAVIOLET RADIATION. Payne, J. A.; Blythe, J. L.; Lowman, H.; Yonce, C. E. (Agricultural Research Services, Byron, GA). Ann. Entomol. Soc. Amer.; 66: No. 5, 1007-1009(Sep 1973).

In cage tests, 93% of laboratory-reared Conotrachelus nenuphar (Herbst) responded positively to blacklight (BL) whereas only 7% responded to natural (ambient) light. Also, the insects were more strongly attracted to BL and filtered blacklight than to red, pink, gold, green, cool green, blue, deluxe cool white, or chroma 70 fifteen-w fluorescent lamps. The curculios were positively attracted to BL up to 2200 ft. (auth)

27637 POSTNATAL GROWTH IN PRENATALLY IRRADIATED RATS. II. Exposure Rate Effects on the Adrenal, Pituitary, Lung, Heart, and Testes. Martin, P. G. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. Growth; 37: No. 2, 165-175(Jun 1973).

The influence of a 160 R exposure to γ radiation, delivered at 1, 3, and 47 R/min to rats in their 18th day of gestation, on postnatal growth of the lungs, testes, pituitary, adrenal, and heart was examined. Organ weights for the three exposure rate groups between birth and day 30 were different from controls. The regressions of organ weight against age for the three exposure rates during this period were not different for the lung, testes, pituitary, and heart but followed a characteristic pattern for that organ. The organ weights for the adrenals for the three exposure rate groups came from a heterogenous sample. Between birth and day 30 an exposure rate effect was noted in two organs, the lung (a cell renewal system) and the testes (a mitotically active differentiating system on day 18). After day 30, the percentage of increase in weights was greater in most of the irradiated organs than in controls and differences in weights were diminished. An exposure rate response was found in the adrenal, heart, and pituitary weight at day 63. Reasons for postnatal recovery responses are discussed. (auth)

27638 GRAFT-VERSUS-HOST REACTIONS IN MICE. III. Epithelioid and Multinucleated Giant Cells of Thymic Origin. Bennett, M.; Montes, M. (Roswell Park Memorial Inst., Buffalo). Amer. J. Pathol.; 71: No. 1, 119-134(Apr 1973).

Thymus cells from C3H donor mice were infused into lethally irradiated (C3H × C57BL/10)F_1 hybrid mice. Light and electron microscopic examination of the lymphoid tissues of recipients revealed the presence of epithelioid and multinucleated giant cells in addition to lymphocytes and histiocytes. Serial transplantation of thymus-derived cells into irradiated F_1 hybrid mice resulted in a preponderance of epithelioid cells over lymphocytes. Epithelioid cells, as well as lymphocytes and histiocytes, incorporated ^{3}H-thymidine, indicating that they were actively proliferating. Following transplantation of CBA-T6T6 thymocytes into irradiated (C3H × C57BL/10)F_1 mice, karotypic analysis of host lymphoid tissues indicated that all dividing cells were of donor origin. Whereas bone marrow is known to give rise to epithelioid cells in the absence of thymic influences, the thymus must also contain precursors of epithelioid cells. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstracts 27061 and 27291.

Man

Refer also to abstracts 27252, 27287, 27288, 27613, and 27664.

27639 ROLE OF SURGERY AND ^{131}I THERAPY OF HYPERTHYROIDISM IN THE ETIOLOGY OF THYROID CARCINOMA. Ashkar, F. S.; Miale, A. Jr.; Smoak, W. M. III; Weinstein, M. B. (Univ. of Miami, FL). S. Med. J.; 66: No. 9, 1014-1016(Sep 1973).

The occurrence of thyroid carcinoma following ^{131}I therapy for thyrotoxicosis is unusual; only nine cases are reported to date in the literature. This study reports four patients who developed thyroid carcinoma following surgical treatment for thyrotoxicosis in a series of 48 patients. Chronic stimulation with endogenous thyrotropin (TSH) and long-acting thyroid stimulator (LATS) after surgery may have some etiologic role in this situation. ^{131}I therapy for hyperthyroidism results in impairment of the reproductive integrity of the thyroid cell, resulting in a high incidence of hypothyroidism and a low incidence of thyroid carcinoma. (auth)

27640 DOSIMETRICAL IMPORTANCE OF RADIOCHEMICAL PURITY OF RADIOACTIVE DIAGNOSTICAL PREPARATION. Predmerszky, T.; Farkas, G. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest). Izotoptechnika; 16: No. 7-8, 406-410(1973). (In Hungarian).

Dose is influenced by the test technique, the individual characteristics of patients, the contamination of preparation and the difference in the metabolism of contamination and the basic compound. (auth)

27641 (BNWL-tr-84) INCIDENCE OF LUNG CANCER AMONG MINERS IN THE ORE MINES OF NORTHERN BOHEMIA. Pekarek, V.; Martinec, M.; Urbanec, J. [nd]. Translated from a Czech paper. 23p. Dep. NTIS $3.25.

A discussion is presented of ore mining in the Northern Bohemian area with regard to mineral contents of veins, ventilation, mining methods, draining of mines, illumination of mines, and dust control. Concentrations of radon in the air of mines are tabulated for the years 1965 through 1967. The radon concentration of mine water is also tabulated. A table is presented to show incidence of lung cancer in miners in relation to years of exposure, age, and dose of alpha radiation to the bronchial epithelium. Case histories are presented of some of the lung cancer patients. The largest number of diseased miners was found in the mine having a radon concentration four times that of other mines. The cumulative doses of alpha radiation to the bronchial epithelium of cancer patients were between 2,125 and 15,375 rem. The role of other factors, such as cigarette smoking, in the incidence of lung cancer is discussed. (HLW)

27642 (CONF-730814-2) BIOLOGICAL DIFFERENCES OF SEGMENTS OF THE POPULATION AND THEIR EFFECT ON DOSE ESTIMATES FOR INDIVIDUALS. Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1973. 20p. Dep. NTIS $3.00.

From 2nd international summer school on radiation protection; Herceg Novi, Yugoslavia (21 Aug 1973).

Data on the intake of air, water, and milk and the composition of the total diet in relation to age are reviewed in relation to the intake of radioisotopes present in the environment by infants and adults of the human population. Results are presented from computer calculations of: the β radiation dose and dose rate to various organs and tissues from the inhalation of 1 μci ^{133}Xe as a function of age and respiration rate; the dose rate to various organs of adult man immersed in an infinite cloud of ^{133}Xe at a concentration of 1 pCi/ml; and the depth dose distribution in man immersed in an infinite cloud of ^{85}Kr at a concentration of 1 μci/ml^3. (CH)

27643 (CONF-730907-9) DOSIMETRIC ASPECTS OF A FORTHCOMING REPORT OF ICRP ON INTERNAL EMITTERS. Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1973. 22p. Dep. NTIS $3.25.

From 3rd international congress of the international radiation protection association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Recommendations of the ICRP for procedures to be used in estimations of the internal dose to man from the uptake of certain radionuclides from the environment are discussed. The principle of dose commitment used in recommendations of maximum permissible intake of radionuclides by occupationally exposed personnel and the general human population is considered. Criteria for estimations of radiation dose distribution in critical organs following the uptake of radionuclides are presented. A procedure for computing the time integral of activity of radionuclides (and daughter products) in various organs and subregions in relation to the radiation dose is described. (CH)

27644 (CONF-730915-2) CONTRIBUTION OF RADON IN NATURAL GAS TO THE DOSE FROM AIRBORNE RADON DAUGHTERS IN HOMES. Barton, C. J.; Moore, R. E.; Rohwer, P. S. (Oak Ridge National Lab., Tenn.). 1973. Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Many determinations of the radon content of natural gas at the wellhead have been reported, but little information has become available on the concentration of this radioactive rare gas in the natural gas entering homes. Also, little effort has been devoted to evaluation of doses that gas users receive from this natural source of radioactivity. A three-part program was devised to supply the missing information. The first part consisted of gathering data on the radon content of natural gas being supplied to several metropolitan areas in the United States. The second part involved the calculation of radon daughter concentrations in homes produced by use of natural gas in an unvented home appliance. The last phase combined data from the first two parts of the program with the average of published estimates of the dose conversion factor for radon daughters deposited in the human respiratory system to provide dose estimates for exposure to this source of natural radioactivity. To put these doses in perspective, a comparison was made with the dose received from radon daughters produced by decay of radon in the atmosphere. (22 references) (CH)

27645 TWO CASES OF TRITIUM FATALITY. Seelentag, W. (World Health Organization, Geneva). pp 267-280 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Two cases of radiation syndrome that resulted in death of personnel engaged in the production of tritiated luminous compounds for a period of three to six years are reported. Both had previously been engaged in the production of luminous compounds using ^{226}Ra and ^{90}Sr. Activities of tritium used ranged from 100 up to several thousand Ci/yr. Both cases exhibited typical symptoms of radiation syndrome and autopsy samples showed a marked reduction in bone marrow cells as the immediate cause of death. The tritium concentration in urine and other body fluids of one individual was 110 nCi/ml, with average content in bone marrow calculated to be 24 nCi/gm and 25 nCi/gm in the testis. The second individual had a whole-body exposure of about half this amount. The whole-body dose was calculated as 300 rem over a six-yr period for one individual and less than 1000 rem during a three-yr period for the other. Data on several other personnel who received chronic exposure to tritium, as determined by measurements of tritium in the urine, made before and after stopping work with tritium are included. (CH)

27646 BIOKINETICS OF ENVIRONMENTAL TRITIUM. Moghissi, A. A.; Patzer, R. G.; Carter, M. W. (National Environmental Research Center, Las Vegas, NV). pp 314-322 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Data relevant to the evaluation of radiation hazards to human populations from tritium released to the environment by nuclear explosives, nuclear reactors, and other nuclear facilities are reviewed. A simplified model for tritium transport in the environment is presented that delineates pathways for tritium uptake by man by inhalation or ingestion. The model is applicable to estimation of the internal dose from tritium uptake for personnel of a nuclear facility or the population in the immediate vicinity of a source of tritium release. It is pointed out that, although tritium enters the ecological cycle in the form of water, it soon becomes a part of all hydrogen-containing compounds and that an adequate evaluation of tritium movement through various chains of the ecological cycles would require knowledge of the kinetics of reactions between chemical compounds of living organisms, including reaction orders and reaction rates. A simplified method for estimation of the radiation dose to man from incorporated tritium is described that is based on the assumption of steady-state equilibrium of different hydrogen isotopes in various components of the biological system. Appropriate equations are presented for calculation of the dose equivalent in mrem/a in relation to tritium concentration in body water and quality factor. (24 references) (CH)

Animals

Refer also to abstracts 27601, 27602, and 27670.

27647 (TID-26438(APP.2)(VOL.1)) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN RATS. Appendix II. Autopsy Report. Volume 1. (Food and Drug Research Labs., Inc., Maspeth, N. Y. (USA)). 5 Jan 1970. Contract AT(30-1)-3734. 334p. Dep. NTIS $18.75.

The autopsy reports of rats fed diets of irradiated bananas are reported. The rats were fed the bananas to the extent of 35% of their total diet for a period of 2 yrs. The bananas were irradiated with a ^{60}Co source at doses of 0, 20, and 40 kilorads. (ERB)

27648 (TID-26438(APP.2)(VOL.2)) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN RATS. Appendix II. Autopsy Report. Volume 2. (Food and Drug Research Labs., Inc., Maspeth, N.Y. (USA)). 5 Jan 1970. Contract AT(30-1)-3734. 335p. Dep. NTIS $18.75.

The autopsy reports of rats fed diets of irradiated bananas are reported. The rats were fed the bananas to the extent of 35% of their total diets for a period of 2 yrs. The bananas were irradiated with a ^{60}Co source at doses of 0, 20, and 40 kilorads. (ERB)

27649 (TID-26438(APP.3)) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN RATS. Appendix III. Individual Organ Weight Data. (Food and Drug Research Labs., Inc., Maspeth, N.Y. (USA)). 5 Jan 1970. Contract AT(30-1)-3734. 238p. Dep. NTIS $14.00.

The individual organ weight data obtained at autopsy from rats fed diets of irradiated bananas are presented in tabular form. The rats were fed irradiated bananas to the extent of 35% of their total diet for a period of 2 yrs. The bananas were irradiated with a ^{60}Co source to a dose of 0, 20, or 40 kilorads. (ERB)

27650 (TID-26438(APP. 4)) CHRONIC TOXICITY STUDIES ON LOW-DOSE IRRADIATED BANANAS IN RATS. Appendix IV. Original Pathological Data. (Food and Drug Research Labs., Inc., Maspeth, N.Y. (USA)). 5 Jan 1970. Contract AT(30-1)-3734. 248p. Dep. NTIS $14.50.

The gross anatomic and histopathologic findings at autopsy of rats fed irradiated bananas are presented. The rats were fed irradiated bananas to the extent of 35% of their total diet for a period of 2 yrs. The bananas were irradiated with a ^{60}Co source at a dose of 0, 20, or 40 kilorads. No significant differences were found between control and treated groups. (ERB)

27651 SOMATIC AND TERATOGENIC EFFECTS OF TRITIUM. Cronkite, E. P. (Brookhaven National Lab., Upton, N. Y.); Robertson, J. S.; Feinendegen, L. E. pp 198-209 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Data relevant to the evaluation of the biological hazards of tritium are reviewed, with emphasis on the hazards from tritium uptake by mammals in the form of tritiated water (TOH) or tritiated thymidine (^{3}HTdR). Methods used for estimating the internal radiation dose to cell nuclei and cytoplasm and the dose absorbed by various tissues from incorporated tritium are discussed. Data are reviewed from studies of the somatic effects of TOH incorporated into the body water of mammals and the effects of ^{3}HTdR uptake by DNA in cell nuclei during the DNA synthesis phase of the proliferative cycle on cultured cells and intact mammals. The toxicity of TOH and ^{3}HTdR following single, multiple, or chronic administration is discussed in relation to the radiation dose and dose rate. Problems presented in studies of the effects of very low levels of β particles from TOH in mammals are discussed. (38 references) (CH)

27652 BIOLOGICAL EFFECT OF CERTAIN TRITIUM LABELED COMPOUNDS RELATED TO DOSE. Lambert, B. E. (National Radiological Protection Board, Sutton, Eng.). pp 210-221 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The biological effects of various tritium-labeled compounds in relation to dose were studied using death of cells of the mouse testes as the criteria for radiation damage following intraperitoneal injection of uridine, methionine, thymidine, and tritiated water. Methods used to estimate the radiation dose to the testis are discussed. Studies on the effects of ^{35}S-methionine were included for comparison. Data are presented on the average organ dose following the injection of 2 μCi/gm body weight of tritium-labeled compound. No difference in cell killing effect in relation to activity injected was observed during the 90-hr period following injection. (32 references) (CH)

27653 QUALITY FACTOR FOR TRITIUM RADIATION. Johnson, H. A. (State Univ. of New York, Stony Brook). pp 231-239 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Experimental evidence used in establishing the RBE of tritium β particles is reviewed, with emphasis on the uncertainties involved. Estimates of RBE based on administration of tritiated water to mammals and comparison of effects on cells in vitro in relation to LET with effects of 250 kvp x radiation, ^{60}Co γ radiation, and ^{226}Ra γ radiation are discussed. It was concluded that a quality factor of 2 be used in estimating the biological risks from a given absorbed dose of tritium β radiation. (18 references) (CH)

27654 RELATIVE BIOLOGICAL EFFECTIVENESS OF TRITIUM. Moskalev, Y. I.; Zhuraviev, V. F.; Istomina, A. G.; Petrovich, I. K.; Kazbekova, D. A. (Inst. of Biophysics, Moscow). pp 240-244 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Results of studies on the biological effects of tritium β particles in comparison with those of γ radiation from ^{137}Cs are reviewed. The experiments were performed using 587 rats, with tritiated water given in quantities ranging from 0.15 to 3.0 mCi/gm body weight. Other rats were continuously exposed to γ radiation of ^{137}Cs at the same incident dose rate as was calculated for the tritium. The RBE of tritium was measured in terms of survival rate, peripheral blood response, and changes in the weight of spleen and thymus. Analysis of the results indicated the RBE of tritium β particles lies between 1.45 and 1.93 and is biologically more effective than γ radiation of ^{137}Cs. The greater RBE of tritium appeared to be related to the fact that it develops 10 to 30 times as great ionization density per unit tissue volume as x or γ radiation. (CH)

27655 TRITIUM OXIDE TRANSFER THROUGH PLACENTA, ITS INTAKE WITH MILK, AND BIOLOGICAL ACTION OF TRITIATED WATER ON THE FETUS. Moskalev, Yu. I.; Lyaginskaya, A. M.; Isotomina, A. G. (Inst. of Biophysics, Moscow). pp 245-251 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Results are reported from studies on the tissue distribution and pathological effects of tritium oxide in pregnant and lactating rats and their fetuses and neonatal offspring following administration of single, multiple, or chronic doses of tritiated water to the mother and transfer through the placenta or milk to offspring during various phases of development. The dose administered was 0.3 mCi/gm of maternal body weight. Studies were also made on neonatal rats given multiple doses of 5.10 μCi/gm tritiated water during the first 22 days of life. Results of the study indicated that tritium oxide administered to the mother is rapidly transferred to fetuses and nursing offspring. Pathological changes in offspring were dependent on the developmental stage at the time of tritium oxide uptake. (CH)

27656 TUMOR INCIDENCE IN C57 BLACK/6 MICE TREATED WITH TRITIATED THYMIDINE. Mewissen, D. J.; Rust, J. H. (Univ. of Chicago). pp 252-267 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Approximately 1,400 newborn mice were given subcutaneous injections of tritiated thymidine at dose levels ranging from 0.3 to 1.5μ Ci/gm body weight and observed during their entire life span or up to 1,200 days for incidence of tumors in comparison with controls. Only 862 injected mice reached adult life. A significant increase in overall tumor incidence was observed in the injected mice, with increased incidence of lymphosarcomas predominant. Data on age-specific tumor incidence rate are presented. No statistically significant dose-response relationship for tumor induction was derived. (CH)

27657 CHROMOSOMAL CHANGES IN CHINESE HAMSTER CELLS FOLLOWING CUTANEOUS EXPOSURE TO TRITIATED LUMINOUS COMPOUNDS. Colvin, M. C.; Everts, J. M. (Environmental Protection Agency, Montgomery, AL). pp 281-284 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritiated luminous compounds, with specific activity of 20 or 200 mCi/gm, were applied to small skin areas of hamsters for a period of eight hours. Groups of hamsters were sacrificed at 7 and 30 days post exposure and the number and type of chromo-

some aberrations in cultured cells of lung and kidney tissues were compared with controls. The results showed that tritium was absorbed through the skin, as indicated by the excretion of significant amounts in the urine of the test animals. The number of chromosome aberrations in both lung and kidney tissues of animals exposed to both compounds was several times greater than that observed in controls, with the most common type being chromated breaks indicative of damage during the G2 phase of the cell cycle. (CH)

Microorganisms

Refer also to abstracts 27596 and 27690.

Nuclide Kinetics and Toxicology

Refer also to abstracts 27291, 27305, and 29476.

Man

Refer also to abstracts 27082, 27244, 27290, 27304, 27308, 27309, 27312, 27324, 27371, 27376, 27600, 27639, and 27641.

27658 (BNWL-1751(Pt.2), pp 95-96) EVALUATION OF HUMAN POSTMORTEM TISSUE SAMPLES FOR TRANSURANIUM ELEMENTS. Nelson, I. C.; Thomas, V. W. Jr. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Collection of postmortem tissue samples (lung, liver, bone and tracheobronchial lymph nodes) from individuals residing or formerly residing in the vicinity of the Hanford complex continued during the past year. Postmortem tissue samples and blood samples were also received from the U. S. Transuranium Registry for analyses for transuranium elements. (CH)

27659 (BNWL-tr-87) DISTRIBUTION OF ABSORBED DOSAGE OF ALPHA-ACTIVE AEROSOL PARTICLES OVER TISSUE DEPTH. Salmanson, Yu. E.; Chutkin, O. A. Translated from Gig. Sanit.; 37: No. 3, 47-51(1972). 5p. Dep. NTIS $3.00.

A calculation was made of the dependence of an absorbed dose in tissue on distance from the aerosol particles of the alpha-active isotope considering the irregularity of linear losses of alpha irradiation energy along the path and real energy spectra of aerosol particles. Presented are calculation results for one of the most important isotopes frequently encountered in practice, i.e. ^{239}Pu. It is shown that dose distribution by tissue depth is such a strongly variable function that this must be taken into account in assessing the risks of alpha-active aerosols. (This appeared from the original language in NSA as abstract 26: 45444.) (auth)

27660 (CONF-730814-3) AGE DEPENDENCE OF UPTAKE AND RETENTION OF RADIONUCLIDES. Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1973. 19p. Dep. NTIS $3.00.

From 2nd international summer school on radiation protection; Herceg Novi, Yugoslavia (21 Aug 1973).

Data are reviewed from studies on the uptake and distribution of ^{65}Zn, tritium, ^{137}Cs, ^{85}Sr, ^{90}Sr, ^{131}I, ^{224}Ra, and ^{239}Pu in relation to the internal dose of man or experimental animals. The value of whole-body counting for estimations of the internal dose from deposited radionuclides in man is stressed. The concept of using the man-rem unit for expression of the radiation dose commitment for human populations residing within 50 miles of nuclear power plants in the USA is discussed. (CH)

27661 (LA-UR-73-834) BIOMEDICAL FOLLOW-UP OF THE MANHATTAN PROJECT PLUTONIUM WORKERS. Hempelmann, L. H.; Langham, W. H.; Voelz, G. L.; Richmond, C. R. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 7p. (CONF-730907-12). Dep. NTIS $3.00.

From 3rd international congress of the international radiation protection association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Long-term studies were performed on 25 men who were exposed to plutonium during World War II at what is now the Los Alamos Scientific Laboratory. Almost all of the subjects had body burdens of plutonium ranging from 0.1 to 1.3 μg or 6 to 80 nCi of relatively pure plutonium-239 as estimated from the urine assay method for plutonium used at Los Alamos prior to 1950. The war-time exposure conditions, estimates of body and lung burdens based primarily on urine assay for plutonium and the medical studies that have continued during the intervening years are discussed. (auth)

27662 (NP-19851) ASSAY OF STRONTIUM-90 IN HUMAN BONE IN THE UNITED KINGDOM. Results for 1970. (Medical Research Council, London (England)). 1970. 21p. Dep. NTIS (U. S. Sales Only) $3.25. UK 23 ½ pence.

The results of ^{90}Sr determinations in human bone samples in the United Kingdom are presented. The data, 1970 results, reflect the age dependence of the results. (ERB)

27663 (ORNL-TIRC-73-18) DIAGNOSIS, TREATMENT, AND OCCURRENCES OF RADIONUCLIDE CONTAMINATION OF WOUNDS: A BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Apr 1973. 19p. Dep. NTIS $5.00.

This bibliography, of 164 selected references, was prepared by the Toxicology Information Response Center in reply to a specific request. The citations are divided into primary and secondary references, and each section is arranged by year and alphabetically by first author within each year. The sources searched covered a twenty-year time span, from 1952 through March 1973. The bibliography contains citations about both accidental and experimental incidences of wound contamination. The radionuclides primarily concerned are alpha emitters, with a few references to beta and gamma emitters. (auth)

27664 (SSI-1972-33) INVESTIGATION OF RADIOACTIVE CONTAMINATION OF PERSONNEL AT NUCLEAR MEDICINE INSTITUTIONS. Falk, R.; Magi, A.; Sarby, B. (National Inst. of Radiation Protection, Stockholm (Sweden)). Nov 1972. 24p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.25.

Contaminated of personnel at two hospitals in Stockholm, Sweden has been investigated. Both internal and external contamination with ^{131}I and ^{99m}Tc were found. The thyroid was found to contain around 1 nCi for each of the isotopes. The external contamination of hands and hair was about the same as the internal. Half of the internal contamination with ^{131}I was caused by inhalation of airborne radioactivity, and the other half of intake through the mouth as a result of external contamination. Also personnel at nursing departments where patients who have been treated with ^{131}I are kept showed the same level of internal contamination as the result from airborne radioactivity. Internal contamination with ^{99m}Tc was caused by intake through the mouth from contaminated hands. (SW)

27665 TRITIUM TURNOVER RATES IN MAMMALS. Robertson, J. S. (Brookhaven National Lab., Upton, NY). pp 322-327 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The most important tritium containing compound in the environment is water, which is the most important form of internally distributed tritium in organisms. It is pointed out that tritium labeled water may enter the body through respiration, ingestion, or diffusion through the skin and the turnover rate is similar to that of water. Data are reviewed from a number of studies on the distribution of tritium labeled water in mammals following acute or chronic uptake through various routes. The possibility of isotopic discrimination leading to increased specific activity in the body is discussed. It is pointed out that some tritium labeled compounds are known to concentrate in locations that increase their radiobiological effectiveness. In particular, the uptake of tritiated thymidine by DNA molecules is cited. It was concluded that for acute exposure, calculation of the internal radiation dose from tritium using the ICRP half-time of 10 days is reasonable, but for chronic exposures the total dose should be taken as about 1.5 times that calculated for water because of the incorporation of tritium in organic compounds. (28 references) (CH)

27666 TRITIUM EXCRETION IN MAN UNDER TROPICAL CONDITIONS. Sadarangani, S. H.; Sahasrabudhe, S. G.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). pp 327-333 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Personnel working in and around tritium contaminated areas take small quantities of tritium into their body by skin absorption, inhalation, and ingestion as oxide. Since tritium is distributed uniformly in all body fluids it gives uniform internal exposure. The internal radiation dose from tritium in man can be calculated if the biological half-life is known. Since the biological half-life of tritium depends on ambient temperature and food habits, such as water intake, it was concluded that values for a standard western man would not be valid in tropical regions. Experiments conducted on human volunteers in India indicated that in that region the biological half-life for tritium in man is

approximately seven days as compared to 10 days used by ICRP in deriving MPC values. (13 references) (CH)

27667 HUMAN TRACE METAL BURDENS. Howells, G. (Natural Environment Research Council, London). pp 63-80 of Chemical Analysis of the Environment and Other Modern Techniques. Ahuja, S. (ed.). New York; Plenum Publishing Corp. (1973).

The composition of man is an important and worthwhile objective for study. Although important, however, it is an aim difficult to achieve. Only a very few whole bodies (apart from still-born babies) have been analyzed. These few are sufficient to indicate that there is considerable variation due to age, sex, occupation, environment, and the immediate past history of health, as well as more fundamental differences due to genetic or ethnic differences. It is clear that the few data available cannot provide for a standard or reference base-line. (auth)

27668 RELATION OF TRACE METALS TO HUMAN HEALTH EFFECTS. Schroeder, H. A.; Darrow, D. K. (Dartmouth Medical School, Brattleboro, VT). pp 81-104 of Chemical Analysis of the Environment and Other Modern Techniques. Ahuja, S. (ed.). New York; Plenum Publishing Corp. (1973).

The effects of various trace elements on human health have been reviewed, in the light of annual industrial consumptions, natural abundances on the earth's crust and in sea water, and contents of Reference Man, as well as changes in experimental animals fed low doses for life. Fourteen metals and two non-metals are essential for life or health of mammals, all but two of which are mined in large amounts, are abundant on the earth's crust, and are found in human tissues in sizeable quantities. Most of these metals are non-toxic to mammals in ordinary concentrations. Five metals occur in low abundances, are consumed industrially in sizeable amounts, occur in the body of man and are toxic of themselves. Lead and cadmium are prevalent in man. Nine metals have low orders of toxicity and occur at low crustal abundances. Eight have little or no toxicity, of which six are abundant. Metals in the environment of potential hazard to man are lead, by far the largest pollutant, cadmium, which may influence hypertension and emphysema, nickel as the carbonyl which is carcinogenic, antimony which is toxic, beryllium which can cause beryllosis, and methyl mercury which is highly toxic. At present levels of exposure, lead, cadmium and possibly nickel are potentially hazardous to health. Only under special circumstances and in special compounds are a few other elements hazardous. (auth)

Animals

Refer also to abstracts 27301, 27310, 27311, 27316, 27317, 27627, 27696, and 29469.

27669 (BNWL-1782) BIOLOGY OF THE TRANSURANIUM ELEMENTS. A Bibliography. Thompson, R. C. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1973. Contract AT(45-1)-1830. 132p. Dep. NTIS $8.75.

A bibliography is presented of more than one thousand literature citations on the biological behavior and effects of the transuranium elements. Associated with each bibliographic entry is a unique code used in cross-indexing of junior authors and to be used for future subject indexing. (HLW)

27670 (BNWL-tr-85) EXPERIMENTAL BRONCHO-PULMONARY CANCER IN THE RAT CAUSED BY RADON INHALATIONS (COMPARISON WITH HISTOLOGICAL ASPECTS OF CANCER IN HUMANS). Perraud, R.; Chameaud, J.; Lafuma, J.; Masse, R.; Chretien, J. Translated from J. Fr. Med. Chir. Thorac.; 26: No. 1, 25-41(1972). 22p. Dep. NTIS $3.25.

Rats were allowed to inhale cerium hydroxide dust and radon; they were weighed every day and pulmonary x rays were taken periodically. After the rats were killed, blood was removed and histological examinations were made of thoracic organs. Bronchopulmonary carcinomas were observed in all rats; they were of two types, epidermoid and adenocarcinomas. Histological characteristics of the carcinomas are described and comparisons with human carcinomas are given. (HLW)

27671 (CEA-N-1652) MEASUREMENT TECHNIQUES USED FOR THE STUDY OF THE METABOLISM OF ORGANIC TRITIUM. Jeanmaire, L.; Vernois, Y.; Bullier, D. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jun 1973. 18p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Measurement techniques used for an experimental study of the metabolism, in the rat, of tritium bound to labeled molecules are described. The difficulties met in such a study are stated, and a detailed description of the selected apparatus and its use is given. (FR)

27672 (CONF-710501-P1, pp 76-80) TRANSFER OF RADIOCESIUM IN MILK FROM REINDEER COW TO CALF. Holleman, D. F.; Luick, J. R.; White, R. G. (Univ. of Alaska, College) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The retention of radiocesium by reindeer and the transfer of radiocesium from reindeer cow to calf via milk were investigated for a group of reindeer maintained under natural grazing conditions. These studies were conducted at the Reindeer Research Station, Cantwell, Alaska. Experimentally the study consists of injecting ^{134}Cs intravenously into a reindeer cow, whole-body counting the cow and calf with a portable scintillation counting system periodically for 15 to 18 days thereafter, then injecting the calf intravenously with ^{134}Cs and continuing the whole-body counting for a period of approximately 15 to 20 days, and finally simulating the transfer with an analog computer. The buildup of radiocesium in milk was rapid and subsequently declined at a rate similar to that of plasma cesium. The calf reached a maximum body burden at 3 to 4 days following the injection of the cow. A method of using ^{134}Cs to estimate milk intake of the calf is presented. (auth)

27673 (CONF-710501-P1, pp 247-252) TURNOVER OF ZINC-65 AS AN INDEX OF ENERGY METABOLISM OF PEROGNATHUS LONGIMEMBRIS, THE LITTLE POCKET MOUSE. Chew, R. M.; Hemington, J. G. (Univ. of Southern California, Los Angeles) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Tracer amounts of ^{65}Zn in a glycine complex were injected subcutaneously in P. longimembris kept at 31.8, 23.8, and 9.1 C. Retention of the ^{65}Zn was measured for 75 to 96 days; oxygen consumption of groups of eight mice was measured for days 5 to 9 or 6 to 10 after injection. The mice had significantly different mean daily oxygen consumptions at the three temperatures. The rate of ^{65}Zn excretion was significantly different for all groups in the second phase of excretion (days 5 to 25 or 30). The rate of excretion for the third phase (after day 25 or 30) was significantly different for the 31.8 and 9.1 C groups, and for the 23.9 and 9.1 C groups. Mean daily metabolic rate was significantly correlated with the rate of excretion during the oxygen measurements ($r = 0.9999$, $P \sim 0.01$), and with the area under the semilogarithmic retention curve for days 0 to 60 ($P < 0.05$). Measurements of ^{65}Zn turnover are potentially useful for estimating the mean daily metabolic rate of free-living mice. More information is needed on the effect of factors in the natural diet on turnover, and on individual variation. (auth)

27674 (CONF-710501-P1, pp 285-306) BIOLOGICAL PATHWAY OF ZINC (^{65}Zn) IN FRESHWATER FISH AND ITS ALTERATION BY HEAVY METALS. Merlini, M.; Argentesi, F.; Berg, A.; Brazzelli, A.; Oregioni, B.; Pozzi, G. (Joint Research Center, Ispra, Italy) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The biological pathway of ^{65}Zn was studied in the freshwater fish Lepomis gibbosus, L. from Lago Maggiore (Lake Maggiore) in Northern Italy under different experimental conditions. The results showed that the biological half-times of accumulation (T_{ba}) and the rates of accumulation (k) of radiozinc from water by fish fed rations with 16 ppM of stable zinc and for fish fed a zinc-free diet were significantly different. In the first case, the T_{ba} was 97 days and k was equal to 0.007 per day; whereas in the second case, for fish on a zinc-free diet, the T_{ba} was 27 days and the rate of accumulation was 0.027 per day. Fish without stable zinc in their diet accumulate their body burden at a faster rate than those with zinc in their diet. In addition, fish fed zinc-free ration accumulated significantly more radiozinc than those on a normal diet. The bioelimination of radiozinc accumulated from water by the sunfish was in two phases: a rapid phase (11 days), and a slower one (167 days). There were two periods for the bioelimination of radiozinc from marked food: the rapid, representing nonassimilated tracer was 1.29 days; the slower phase, due to metabolized radiozinc that had entered body pools with fast and intermediate turnover rates, was 25 days. A third and longer component is proposed from supplementary data and reports in the literature. From the % weight and % activity data calculated for different segments of the fish, it was learned that: muscle and bone account for about 50% of the total weight of the fish but for 23% of the total activity; the head represents 28% of the weight but has 40% of the activity; the external surface (fins + scales + skin) accounts for 14% of the weight and 20% of the activity; the internal organs are 5% by weight with 10% of the total activity; and the gastrointestinal tract is 2.8% by

weight with 8% of the total activity. The percentage of stable Zn in each of these parts was strikingly similar to that of the percent activity. Radiozinc concentrated primarily in the gastrointestinal tract and then in the internal organs. The lowest activity was in the muscle tissue. The highest concentrations of stable Zn were in the eyes and kidney; the lowest in the muscle. Results of challenging doses of sublethal amounts of stable mercuric chloride (0.025, 0.05, and 0.1 ppM) or cadmium sulfate (0.17, 0.34, and 0.86 ppM) in water on the uptake of ^{65}Zn by the sunfish showed no effects with Hg until day 26, when 0.1 ppM significantly reduced the uptake. Cadmium at all concentrations significantly reduced the uptake and accumulation of radiozinc in sunfish at all time intervals studied (5, 10, 15, 20, and 26 days). Neither Hg nor Cd, at any concentration, altered the total stable Zn content of the fish. The three concentrations of Cd in the water produced an increase in Cd in the whole fish and in all parts of the fish with the exception of a few organs. From the investigations performed it was ascertained that zinc, an essential micronutrient, is homeostatically controlled by fish and that low levels of pollutants such as mercury and cadmium did not affect the total stable Zn content of the animal within the time limits studied. These metals do, however, inhibit the uptake of zinc as ^{65}Zn and the concentration of the nuclide. (auth)

27675 (CONF-710501-P1, pp 307-317) ACCUMULATION AND RETENTION OF STRONTIUM-85 MARKS BY YOUNG LARGEMOUTH BASS. Shealy, M. H. Jr.; Carlson, C. A. (Cornell Univ., Ithaca, NY) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

First-year mortality in largemouth bass, Micropterus salmoides (Lacépède), is often higher than 90%. To better understand the role of predation by aquatic invertebrates in this high death rate, young bass were marked at four different ages with ^{85}Sr for subsequent use in predation studies. Resulting radiostrontium accumulation and retention curves indicated that this radionuclide is suitable for quantitative marking of prolarval, postlarval, and juvenile bass, but not embryos. Bass embryos were exposed to one, and prolarval and older stages to three, ^{85}Sr concentrations at 20 to 23°C. Exposure energies ranged from 0.0 (controls) to 89.1 μCi/liter of pond water. Twelve-hour radioaccumulation and retention rates were obtained for embryos (2 days old). Radioaccumulations in prolarvae (< 1 day old) were monitored at 12-hr intervals from 12 to 168 hr, in postlarvae (15 days old) at 24-hr intervals from 24 to 144 hr, and in juveniles (40 days old) at 24-hr intervals from 24 to 120 hr. Bass from all accumulation experiments were transferred, after various periods of exposure, to pond water to which no ^{85}Sr was added, and mark retentions were evaluated for periods of up to 106 days. (auth)

27676 (CONF-710501-P1, pp 381-384) ASSIMILATION AND RETENTION OF ZINC-65 BY THE MALLARD DUCK (ANAS PLATYRHYNCHOS). Curnow, R. D. (Colorado State Univ., Fort Collins) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Interpretation of the presence of ^{65}Zn in migratory mallard ducks necessitates an understanding of the metabolism of zinc. Assimilation and retention of ^{65}Zn by the mallard duck (Anas platyrhynchos) as influenced by age and sex, season of year, feather molt, and egg production were investigated. Absorption of oral ^{65}Zn was influenced by season of year but not by the age (5 months and 17 months) or the sex of mature mallards. In March, absorption of ^{65}Zn from the gastrointestinal tract was significantly greater ($P < 0.01$) than in October. The effective half-time of ^{65}Zn in the mallard was affected by sex and season but not by the age of the duck. Zinc-65 retention was significantly greater in male mallards ($P < 0.01$) and in October ($P < 0.01$). Egg production accounted for the elimination of 25% of injected ^{65}Zn. Feather molt in the mallards accounted for a 2 to 8% elimination of retained ^{65}Zn. Causative mechanisms for the observed differences in the absorption and excretion of ^{65}Zn between male and female mallards and between seasons are discussed. (auth)

27677 (CONF-710501-P1, pp 385-389) OCCURRENCE OF RADIONUCLIDES IN THE EXOSKELETON OF TURTLES. Holcomb, C. M. (Mississippi State Coll. for Women, Columbus); Jackson, C. G. Jr.; Jackson, M. M.; Kleinbergs, S. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

An investigation was conducted of the levels of radioactivity in the osseous exoskeletons of turtles in southeastern United States. One hundred two individuals collected from six states, representing two families, six genera, and eight species, were examined. Radiochemical analysis confirmed ^{90}Sr to be the radionuclide present in the shell. Individuals varied in body burdens of ^{90}Sr from 0 to 282 pCi/g bone ash. Geographic differences were found, as well as inverse correlations between animal size and body burden of ^{90}Sr in some taxa. (auth)

27678 (CONF-710501-P1, pp 390-393) UPTAKE AND RETENTION OF TUNGSTEN-181 BY CRAYFISH (CAMBARUS LONGULUS LONGEROSTRIS ORT.). Reed, J. R.; Martinedes, B. A. (Oak Ridge National Lab., TN) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The whole-body uptake and retention of ^{181}W was studied in crayfish (Cambarus longulus longerostris Ort.). During a 16-day uptake period in which the medium was not renewed, large animals accumulated more ^{181}W than small ones, but uptake per gram was similar (10^5 dis/min/g) for small and large crayfish. The whole-body elimination curve for ^{181}W consisted of two components, a rapid one-day component and a second slower component with a biological half-time of 12.2 days. The exoskeleton, GI tract, hepatopancreas, and gills reached concentrations of 10^5 dis/min/g during 14 days of ^{181}W uptake from water, and the muscle and gonads reached 10^4 dis/min/g in the same time interval. The most rapid uptake occurred in the hepatopancreas and GI tract. (auth)

27679 (CONF-710501-P1, pp 599-602) TEMPERATURE EFFECTS ON THE SORPTION OF ^{137}Cs, ^{85}Sr, AND ^{65}Zn BY FRESHWATER SHRIMP. Harvey, R. S. (Savannah River Lab., Aiken, SC) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

A 12°C temperature differential was not a major factor in the sorption of ^{137}Cs, ^{85}Sr, and ^{65}Zn by the freshwater shrimp Palaemonetes paludosus (Gibbes). Although sorption levels varied inversely with temperature, radionuclide concentration in whole shrimp (expressed as pCi/mg wet weight) decreased by factors <3 as water temperatures were raised from 20 to 32°C. Concentrations of a given radionuclide were essentially the same at 29 and 32°C, even though these temperatures were lethal for up to 60% of the test specimens. (auth)

27680 (COO-3173-6) INFLUENCE OF IODINE INTAKE UPON KINETICS OF IODINE METABOLISM IN THE DOG. Progress Report, November 1, 1972–October 31, 1973. Becker, D. V.; Belshaw, B. E. (Cornell Univ., New York (USA). Dept. of Medicine). 1973. Contract AT(11-1)-3173. 25p. Dep. NTIS $3.25.

Progress is reported on the following studies of specific aspects of iodine metabolism; the necrosis of thyroid follicular epithelium induced by administration of large doses of iodide to iodine-deficient beagles; the unaccounted loss of a significant fraction of administered radioiodine and of daily stable iodine intake in the dog; and the kinetics of iodine metabolism in the dog at both normal and low levels of iodine intake and a comparison between man and dog on the basis of the model of iodine metabolism in the dog. (HLW)

27681 (FOA-4-4550-A-3) TRANSFER OF SIMULATED FALLOUT-PARTICLES FROM PASTURE TO GRAZING DAIRY CATTLE. III. Experiments with Wet Deposited 1 μm and 100 to 200 μm Particles and Dry Deposited 100 to 200 μm Particles. Ekman, L.; Eriksson, A.; Greitz, U. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Aug 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The transfer of simulant fallout particles from pasture to grazing cows was studied. Experiments were performed with wet deposited silica sand particles in two size ranges with diameters of 100 to 200 μm and about 1 μm, and with dry deposited 100 to 200 μm particles. The particles were labeled with ^{140}La or ^{141}Ce. The fraction of the deposited material ingested by the animals was assessed by measuring the content of radioactivity in feces. On the average 15 (range 6 to 25) % of the wet deposited 100 to 200 μm particles was consumed by the grazing cows. In identical experiments performed the previous year on the average 18% (range 6 to 27) was recovered in feces. Based on these two year experiments it seems reasonable to assume that the initial retention of close-in fallout particles deposited in connection with precipitation will vary between 5 and 25%. The retention of wet deposited 1 μm particles (corresponding to worldwide fallout) was in general somewhat higher than the simultaneously deposited 100 to 200 μm particles. In warm dry summer weather the retention of dry deposited 100 to 200 μm particles was of the order of 1 to 2%. In experiments performed in the autumn when the weather

was colder and the air humidity higher with some dew in the grass the retention was considerably higher and at about the same level as after wet deposition. (auth)

27682 DISTRIBUTION OF TRITIUM BETWEEN THE HYDROSPHERE AND INVERTEBRATES. Bruner, H. D. (Atomic Energy Commission, Washington, DC). pp 303-314 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Data are reviewed from a number of studies on the uptake of tritium from their environment by aquatic and terrestrial invertebrates and plants, some of which are found in the human food chain. Data are included on the specific activity of tritium in the sample relative to the specific activity of the medium. It is pointed out that the term specific activity should be limited to expression of the ratio of the number of atoms of tritium to the number of atoms of hydrogen in the sample. The specific activity of tritium may be determined in the aqueous fraction of a biological sample (usually called free water, free tissue water, or loosely bound water), or in the bound hydrogen or organically bound hydrogen fraction of the sample (usually called bound water or organically bound water). The data reviewed indicate that most invertebrates do not enrich the organic fractions of their tissues with tritium. (45 references.) (CH)

27683 TRITIUM EXCRETION VIA COW'S MILK AFTER CONTINUOUS INTAKE OF TRITIATED WATER. Kistner, G. N. (Federal Health Office, Berlin). pp 349-355 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Cows were given a single dose of 100 μCi of tritiated water in a single intake, or daily doses of 1.5 to 1.7 mCi for 40 days or 150 days. On the basis of daily consumption of approximately 50 liters of drinking water the chronic intake dose was approximately 30 nCi/ml of tritium, which corresponds to the maximum permissible concentration in water for occupationally exposed persons. Samples of milk, water and organic components, blood, feces, and urine were collected repeatedly during the time period and analyzed for tritium. Milk is made up of approximately 87% water and 12 to 13% dry mass. Results of determinations of the specific activity (pCi/mole H) of water and solid mass of milk showed that the fraction of tritium bound to organic matter excreted in milk is between 5 and 10% of the total present in milk. These tritiated compounds are directly introduced into the metabolism of man. The overall half-life of tritium in milk was approximately the same following 40-day and 150-day intake. Recent studies on the biochemistry and physiology of lactation that offer an explanation of this finding are reviewed. (18 references) (CH)

27684 BIOLOGICAL IMPLICATIONS OF THE APPLICATION OF TRITIATED LUMINOUS COMPOUNDS. Wawerna, J. C. (National Environmental Research Center, Las Vegas, NV). pp 356-363 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The potential hazards of tritiated luminous compounds for human populations, and particularly following ingestion by young children, are discussed. It is pointed out that the amount of tritium absorbed from luminous compounds depends on the route of absorption, the chemical nature of the luminous compound, and the test species. Data are reviewed from studies on rats of the tritium activity absorbed through the skin or gastrointestinal tract from six luminous compounds. Studies of tritium absorption from the GI tract of cats showed that the rat's GI tract absorbed six times more tritium from luminous compounds than did that of cats. Tritium absorbed from luminous compounds was found to be eliminated by at least two distinct half-lives. Tritium absorbed from the GI tract of rats was found to be eliminated from the body faster than cutaneously absorbed tritium. The biological kinetics of tritium absorbed from luminous compounds were found to be similar to that of tritium from any other sources. (14 references) (CH)

27685 BEHAVIOR OF TRITIUM IN FISH FOLLOWING CHRONIC EXPOSURE. Morgan, T. J.; Landolt, R. R.; Hamelink, J. (Purdue Univ., Lafayette, IN). pp 378-381 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Data are presented on the uptake of tritium in channel catfish (Ictalurus punctatus) and bluegills (Leponis macrochirus) during various times up to 24 hr following the addition of tritiated water at a concentration of 40 nCi/ml to water in 100-gal tanks maintained at 23°C at a pH of 7.5 and an alkalinity of 85 ppM measured by the methyl orange method. The time required for catfish to reach the maximum uptake of tritium was approximately 4 hr and 3 hr for bluegills. The difference was attributed to the presence of scales on the bluegills. The maximum concentration of tritium in both species was approximately 75% of that of the media. Channel catfish exhibited a rapid release of tritium with essentially all the tritium being eliminated within four hours following removal from tritiated water. It is pointed out that the findings are relevant to the public health aspects of the development of commercial fish farms in heated effluents from nuclear power plants. (CH)

27686 THYROIDAL PARTICULATE PROTEIN IN THE SYNTHESIS OF THYROID HORMONES: EFFECT OF IODIDE ON ^{131}I DISTRIBUTION AMONG IODOAMINO ACIDS IN IODINE-DEFICIENT RAT THYROIDS. Onaya, T.; Yamada, T. (Shinshu Univ., Matsumoto, Japan). Proc. Soc. Exp. Biol. Med.; 143: No. 4, 1062-1066 (Sep 1973).

The effect of iodide on ^{131}I distribution among iodinated amino acids was studied after separation of thyroid soluble protein, deoxycholate-soluble and deoxycholate-insoluble particulate proteins in rats with iodine depleted and prelabeled thyroid gland. Although iodide caused an increase in labeled thyroxine in all 3 fractions, the effect was the most marked in the deoxycholate-soluble particulate protein and associated with a significant percentile decrease in ^{131}I-DIT and ^{131}I-MIT. It is suggested that thyroidal particulate proteins are also involved in the synthesis of thyroid hormones, at least in rats with iodine depleted thyroids. (auth)

Plants

27687 (ANL-7960(Pt. 3), pp 117-133) TERRESTRIAL ECOLOGY: SULFUR DIOXIDE RESISTANCE IN PLANTS, TRITIUM DYNAMICS IN PLANTS, AND RADIATION EFFECTS ON CARBOHYDRATE SYNTHESIS AND UTILIZATION IN TREES. Kline, J. R.; Stewart, M. L. 1972.

In Radiological and Environmental Research Division annual report, January–December 1972.

Results are reported from a study on the uptake and loss of tritiated water (HTO) in grass vegetation and soil following exposure in a tritiated atmosphere. A chamber containing a tritiated water atmosphere was used to cover small field plots. Mechanisms of uptake by grass leaves and stems were determined and the rate of uptake and loss during periods of daylight and darkness was measured. Tritium content in soil samples down to the 2-cm layer and root content were also measured. The results indicate that the entire plant water pool becomes labeled with HTO from an atmospheric source and that delabeling depends on transpiration during daylight hours. The results also indicate that soils are not likely to become strongly contaminated from brief exposures to tritiated water vapor. Applications of the findings in prediction of the concentration and time course of tritium persistance in terrestrial grassy vegetation following release of HTO vapor to the atmosphere near ground level and in the protection of human populations from tritium uptake through the grass-cattle-milk food chains are discussed. Results are reported from studies on the SO_2 resistance in plants in relation to photosynthetic efficiency. Results are also reported from studies on the effects of various dose rates of γ radiation, up to 10R/hr, on rates of photosynthesis, respiration, and carbohydrate synthesis in red pine (Pinus resinosa) and balsam fir (Abies balsamea) trees exposed in a γ field. (CH)

27688 (CONF-710501-P1, pp 417-424) UPTAKE OF RADIOPHOSPHORUS BY ROOTED AQUATIC PLANTS. Schults, D. W.; Malueg, K. W. (Pacific Northwest Water Lab., Corvallis, OR) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Laboratory experiments were conducted to compare the uptake of phosphorus by roots and foliage of Elodea canadensis, Potamogeton amplifolius, and Vallisneria americana and to evaluate the cycling of radiophosphorus between the sediment and the water medium with the plant as the exchange agent. Intact plants were partitioned into root and foliage environments. For the comparison, the radiophosphorus isotopes ^{32}P and ^{33}P were used simultaneously in the separate environments. Three different root media were evaluated for their influence on phosphorus uptake by the plants: like water, silica sand saturated with lake water, and lake sediment saturated with lake water. All three species had higher uptake

by the foliage than by the roots. For Potamogeton and Vallisneria, uptake by the foliage was greatest for plants rooted in sediment, less for those rooted in sand, and least for those rooted in lake water. For Elodea, uptake by the foliage was not statistically different for the three rooting media. For all experiments, except Vallisneria rooted in sand, there was a direct positive relationship between total uptake and percentage of radiophosphorus derived from the rooting medium. Only about 1% of the radiophosphorus in the foliage medium was transferred downward to the root medium. Up to 54% of the radiophosphorus added to the root medium was transferred through the plant and into the foliage medium. This process may constitute a significant sediment-water nutrient interchange mechanism in the littoral regions of lakes. (auth)

27689 (TID-26433) BEHAVIOR AND EFFECTS OF RADIONUCLIDES IN SOILS AND PLANTS. Three Year Summary, 1971-73. (California Univ., Berkeley). 1973. Contract AT(11-1)-34. 12p. Dep. NTIS $3.00.

Results are reported from studies on: the uptake of ^{137}Cs and ^{85}Sr by roots of tomato plants; the uptake of ^{85}Sr by tomato leaves following foliar application; the effects of Ca, K, and temperature on the uptake of ^{137}Cs by tomato leaves following foliar application; the transport of ^{137}Cs, ^{85}Sr, and ^{106}Ru from roots to shoots of Zea mays; field studies on the effects of β dose in ^{90}Y fallout simulant on the crop yield of corn, lettuce, wheat, potatoes, peas, barley, bush beans, and blackeyed peas; and the effects of the application of artificial dew (water mist) on the retention of ^{90}Y fallout simulant on bush bean and blackeyed pea plants. The design of a plant growth chamber with sealed ^{90}Sr and ^{90}Y β sources to provide a range of β doses ranging from about 200 rads to about 125,000 rads during an 18-hr exposure period is reported. (CH)

Microorganisms

27690 (CONF-710501-P1, pp 372-380) RADIUM UPTAKE BY FRESHWATER ALGAE. Havlik, B.; Robertson, E. (Chalk River Nuclear Labs., Ont.) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Five species of green algae and two species of blue-green planktonic algae were selected for this study. Both the accumulation of radium by algae and its mechanism were studied. Two series of experiments were done. In the first, radium was added only at the beginning of the experiment, and in the second, fresh medium containing the required radium concentration was fed continuously to the algae. The radium concentrations tested were from 10^{-7} to 10^{-9} Ci/liter. During continuous culture, radium was taken up by algae immediately after its addition with no further increase of ^{226}Ra concentrations during the course of the experiment. When ^{226}Ra was added only in the beginning of the experiment there was, after the initial uptake, a decrease in the radium concentration in the algae. Two species of algae showed a true accumulation of radium during the course of the experiment. These species absorbed radium within the cells, whereas the other species absorbed radium mostly on the surface of the cells. The possible effects of ^{226}Ra on algae were studied by measuring the photosynthetic oxygen production, total protein content, and growth activity. For the oxygen production experiments, algae were exposed to radium for 3 and 24 hr. The iodometric method and electroreduction method (Oxygraph) were used for oxygen measurements. Total protein content was measured with an Autoanalyzer unit after three weeks cultivation in the radioactive medium. Each species reacted somewhat differently to the presence of radium in the medium. A radium concentration of 3×10^{-8} Ci/liter decreased the oxygen production of four species of algae by about one-third after 24 hr exposure. (auth)

27691 (CONF-710501-P1, pp 410-416) RELATIONSHIPS BETWEEN PHOSPHORUS-32 ACCUMULATION IN ALGAE, BACTERIA, AND TUBIFICIDS. Stromberg, W. L.; Goodnight, C. J. (Western Michigan Univ., Kalamazoo) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Kinetics of accumulation and retention of ^{32}P were determined for unialgal cultures of Chlorella pyrenoidosa in carrier (52 mg Na_2HPO_4/liter) and carrier-free Knop's solution (modified) using 10 μCi ^{32}P/liter as tracer and a Geiger-Mueller counting system. Accumulation in a carrier-free solution was exponential and approached a 90% efficiency of removal within 30 min. In the carrier solution, accumulation was approximately linear and did not reach equilibrium within a 27-hr period. Using ouabain as an inhibitor, it was shown that the observed sorption of radiophosphate in carrier-free solution by this alga was independent of metabolic activity. Most loss of the phosphate taken up in a 27-hr interval occurred within 1 hr in agitated carrier and carrier-free Knop's solution. Accumulation of ^{32}P by tubificid worms was also studied using similar counting methods. Uptake by these worms was approximately exponential in media with a bacterial source of radiophosphate, and was reduced by addition of chloramphenicol and removal of ^{32}P from solution by algae. Preliminary results indicated that C. pyrenoidosa competed effectively with the worms for inorganic phosphate, and that accumulation of ^{32}P by ingestion of algae among tubificids may be slight. Ecological implications of these results are discussed. (auth)

27692 (CONF-710501-P1, pp 652-659) RADIONUCLIDE TECHNIQUE FOR THE ASSAY OF PHYSIOLOGICAL ACTIVITY OF ALGAE. Rich, E. R.; Waldman, L. E. (Univ. of Miami, FL). 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Laboratory and field systems were developed to assay the effects of various environmental factors on organisms that concentrate iodine. The method is an adaptation of ^{131}I tracer studies. The particular application measured the rate of ^{131}I uptake as an indirect assay of the metabolic response to environmental temperature. A specially designed circulating water system permitted work with a wide range of temperatures under closely controlled conditions of light and water quality. This system had the advantage that all of the experimental containers shared the same water, although temperature could be varied. If there was a change of a constituent or modification of the water by the subject organisms, all were equally affected. In laboratory studies, the temperature response curves for two species of estuarine algae were found to be remarkably similar, with sharp breaks indicating the threshold of thermal damage. A field technique was developed and tested. The ^{131}I uptake has broad potential application in the study of the physiological effects of environmental factors. (auth)

New Tracer Techniques

Refer also to abstracts 27102, 27113–27116, 27118, 27128, 27138, 27640, 27692, and 29468.

27693 (CONF-710501-P1, pp 486-491) FEEDING RATES AND FOOD UTILIZATION OF STREAM CADDISFLY LARVAE OF THE GENUS NEOPHYLAX (TRICHOPTERA: LIMNEPHILIDAE) USING COBALT-60 AND CARBON-14. Sedell, J. R. (Univ. of Pittsburgh, Linesville, PA) 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

Feeding rates and food utilization by N. concinnus were determined using ^{60}Co and ^{14}C as food markers and experimental designs that used the individual as a block in order to eliminate individual variation. Using a short-term radionuclide method employing ^{60}Co, passage rates of food through the gut were determined for two different instars. The type of microflora on the natural substrate did not significantly affect ingestion rates. Naturally occurring foods on stream rocks were tagged with ^{60}Co, ^{14}C-bicarbonate, and ^{14}C-glucose. Instar III and IV animals were allowed to feed on the dual-tagged substrates for 1 to 2 hr. Approximate assimilation efficiency for instar III was 15 ± 2% (±S.E.), and for instar IV 26.7 ± 3.0%. When instar IV animals were fed on food tagged with just ^{60}Co and ^{14}C-bicarbonate, the approximate assimilation efficiency was between 4.7 and 6.6%. Differences in assimilation efficiencies are discussed. (auth)

27694 (CONF-710501-P1, pp 492-496) EFFECTS OF ORGANIC INSECTICIDES UPON CARBON-14 UPTAKE BY FRESHWATER PHYTOPLANKTON. Vickers, D. H. (Florida Technological Univ., Orlando); Boyd, C. E. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The effect of ten organic insecticides upon carbon dioxide fixation by phytoplankton was measured in situ by the ^{14}C bioassay technique. The following insecticides were tested individually at concentrations of 10 ppM: dieldrin, endrin, DDT, toxaphene, malathion, methyl parathion, mixex, sevin, matacil, and furadan. Only the carbamates (sevin, matacil, and furadan) and toxaphene consistently inhibited ^{14}C uptake under the test conditions. Further tests with the carbamates revealed that concentrations of 3 to 5 ppM of sevin and matacil resulted in about 50% reduction of ^{14}C uptake as compared with ^{14}C uptake by the control. Concentrations of 15 ppM of these two compounds almost completely inhibited ^{14}C uptake. A

similar response curve was obtained for furadan, but ^{14}C uptake was reduced by only 60% at 15 ppM of this insecticide. The carbamate compounds greatly reduced concentrations of chlorophyll A in phytoplankton cultures within 24 hr. (auth)

27695 (COO-1762-8) GROWTH OF UTERINE, PLACENTAL, AND FETAL VASCULATURE. Final Report. Makowski, E. L. (Colorado Univ., Denver (USA). Dept. of Obstetrics and Gynecology). 1972. Contract AT(11-1)-1762. 6p. Dep. NTIS $3.00.

A technique to measure organ blood flow and its distribution with the use of scintiscanning radioactive microspheres was developed that is useful in organs with multiple arterial supply and venous drainage. The microsphere method was applied to the study of uterine blood flow in pregnant sheep and the in utero estimation of fetal cerebral blood flow. (CH)

27696 TRITIATED WATER TURNOVER RATE IN DESERT MAMMALS. Yousef, M. K. (Univ. of Nevada, Las Vegas). pp 333-341 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Data on water intake and water loss in large and small desert mammals are reviewed. It was concluded that water turnover rate differs from species to species on the basis of efficiency in water expenditure for thermoregulation and the reabsorption and excretion of water by the urinary and digestive systems. The daily water turnover rate may be used as an index for estimation of daily water requirements. Since determination of daily water exchange between an animal and its environment is technically difficult, the use of injected triated water as a tracer to measure daily water loss as an index of daily water intake has proved to be a valuable method. (18 references) (CH)

27697 TRITIUM IN BIOMEDICAL RESEARCH AND CLINICAL MEDICINE. Feinendegen, L. E. (Nuclear Research Center, Juelich, Ger.). pp 647-659 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Tritium is the most widely used tracer for biological research and is being used increasingly as a tracer for medical studies. The specificity of tritium labeling is discussed. Uses of tritium-labeled compounds and molecules described include: hydrogen-tritium exchange techniques for studying macromolecular structure and the effects of structural changes on specific functions; the use of tritium-labeled proteins for endocrinological and immunological studies; the use of tritiated thymidine for studies of DNA synthesis and metabolism in intact cells and for studies on cell proliferation; the use of tritium-labeled DNA for cell killing; and the use of tritium as a tool for the inactivation of relevant biological compounds. (99 references) (CH)

27698 SIMPLIFIED RADIOIMMUNOASSAY OF PLASMA ALDOSTERONE. Varsano-Aharon, N.; Ulick, S. (Veterans Administration Hospital, Bronx, NY). J. Clin. Endocrinol. Metab.; 37: No. 3, 372-379(Sep 1973).

Radioimmunoassay of plasma aldosterone was simplified by the elimination of the chromatographic purification step. A neutral plasma extract is subjected to water/toluene partition and oxidation with periodic acid and the neutral etiolactone product assayed with an aldosterone antiserum which cross-reacts with the etiolactone. Aldosterone concentrations in human plasma determined by this procedure agree with values obtained by other methods. (auth)

27699 ASYMMETRIC IODINATION OF THE HUMAN ERYTHROCYTE MEMBRANE. Reichstein, E.; Blostein, R. (McGill Univ., Montreal). Biochem. Biophys. Res. Commun.; 54: No. 2, 494-500(18 Sep 1973).

Exposure of erythrocyte membrane protein components on the inner and outer cell surfaces was probed using lactoperoxidase-catalyzed iodination. Resealed ghosts derived from ^{125}I-labeled red cells were reiodinated with ^{131}I (a) on the outside by adding lactoperoxidase after the resealing process or (b) on the inside by resealing with lactoperoxidase inside the ghost. SDS-polyacrylamide gel electrophoresis revealed two major radioactive components. One, ~90,000 daltons, was labeled on both surfaces; the other, a glycoprotein, was labeled only on the outer surface. Labeling of large molecular weight protein (>200,000 daltons) was also observed, to a greater extent inside than outside. (auth)

27700 STABLE ISOTOPE TRACERS IN THE LIFE SCIENCES AND MEDICINE. Matwiyoff, N. A.; Ott, D. G. (Los Alamos Scientific Lab., NM). Science; 181: No. 4105, 1125-1133(21 Sep 1973).

A review is presented of the following stable isotopes: ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O, ^{17}O, and ^{18}O. Some important recent developments are reported in the separation, chemical conversion, and quantitative detection of stable isotopes, especially ^{13}C. Potential uses of stable isotopes in life science and medicine are discussed. (DHM)

MATERIALS

27701 (ORO-2413-27) ATOMIC MOBILITY IN SOLIDS. Final Progress Report. Turner, T. J.; Williams, G. P. (Wake Forest Univ., Winston-Salem, N. C. (USA), Dept. of Physics). 1972. Contract AT(40-1)-2413. 64p. Dep. NTIS $5.25.

Data are presented on: Zener relaxation in Ag–Cd, Ag–In, Ag–Au, Ag–Sn, and Ag–Sb; recovery kinetics and short-range ordering of quenched and cold-worked Ag–Au; interval friction of Pb doped with Au, Ag, or Cu; dielectric losses in MgO single crystals; optical reorientation of M centers in alkali metal halides; and optical studies of MgO. (DLC)

For abstracts of individual papers see: 27703 and 28589.

27702 TREATISE ON MATERIALS SCIENCE AND TECHNOLOGY. Volume 2. Herman, H. (ed.). New York; Academic Press, Inc. (1973). 407p. $28.00.

Four reviews are presented on: epitaxial interfaces, x-ray and neutron scattering studies on disordered crystals, structures and properties of superconducting materials, and physical and chemical properties of garnets. Separate abstracts were prepared for the second and third reviews. Author and subject indexes are included. (DLC)

27703 X-RAY- AND NEUTRON-SCATTERING STUDIES ON DISORDERED CRYSTALS. Schmatz, W. (Kernforschungsanlage, Juelich, Ger.). pp 105-229 of Treatise on Materials Science and Technology. Vol. 2. Herman, H. (ed.). New York; Academic Press, Inc. (1973).

In this review, the theoretical framework of x-ray and neutron scattering and experimental techniques are considered. Special topics are then discussed: elastic scattering from single point defects, short-range order and clustering, inelastic neutron scattering at disordered crystals, hydrogen in metals, magnetic point defects, and long-wavelength static disorder. (45 figures, 9 tables, 215 references.) (DLC)

27704 PHYSICS OF THIN FILMS: COMPLETE BIBLIOGRAPHY. Part I. Mayer, H. Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1972). 898p. (In Several Languages).

A card-index compiled over several decades up to Jan. 1, 1969, is published as the first comprehensive bibliography of thin-film physics, indexed according to modern points of view. Work on thin wires and small particles is listed also. The references in this volume are arranged according to author. (DLC)

27705 PHYSICS OF THIN FILMS: COMPLETE BIBLIOGRAPHY. Part II. Mayer, H. Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1972). 329p. (In Several Languages).

A card-index on the physics of thin films is published, covering several decades up to Jan. 1, 1969. This volume is an index to references in Vol. I; the index criteria are review articles and resumes, theoretical publications, preparation, thickness determination, surface/interface/boundary layer, elementary processes on surfaces, film growth and structure, methods for structure determination, mechanical properties, thermal properties, optical properties, electrical properties, superconducting properties, magnetic properties, electron and ion emission, and interaction with particles. (DLC)

27706 IRON PRODUCTION BY ELECTROLYTICALLY OBTAINED HYDROGEN USING NUCLEAR ENERGY. Wortberg, E. J. Aachen; Technische Hochschule (1971). 97p. (In German). Thesis.

A direct reduction process and its economic aspects, using electrolytically obtained hydrogen from cheap nuclear energy in the two-component fluidized-bed, are examined. In the first chapter the technical possibilities and the costs of producing electrolytically obtained hydrogen in units with a capacity of up to 100,000 $Nm^3/H_2/h$ are examined. In the second part, the mechanics of the two-component fluidized bed are investigated. Special importance is given to the theoretical and experimental investigation of the mixing and demixing behavior of two solid components having different specific weights and different grain sizes. The third part of the work deals with the fundamentals of the hydrogen reduction in the two-component fluidized bed. In reduction experiments, it is shown that the reduction of hematite with hydrogen at 800°C with graphite, silicon carbide, and zirconium oxide as inert material can be carried out to a 95% degree of reduction without the occurrence of "sticking." Zirconium oxide and silicon carbide can be suitably used in a technical process as inert material. The graphite is oxidized to CO by the steam produced by the reduction. Thus the inclusion as an inert material in a technical process is not possible. In the final part of the work, the results of the three-part investigations are combined to propose a technical process. The final economic considerations show that the proposed process with the sponge iron requirements of today is no cheaper than other direct reduction methods. Using the steam-phase electrolysis cell with a simultaneous decrease of electrical energy costs, the proposed process can well compete with the other direct reduction methods. (GE)

Ceramics and Cermets

Refer also to abstracts 26990, 27108, 27151, 27795, 27845, 27850, 27867, 27880–27882, 27903, 29188, 29200, and 29266.

27707 (AEC-tr-7461) COLUMNAR GRAIN GROWTH IN CENTER-LINE-HEATED UO_2 PELLETS. Ichikawa, M.; Uchida, M. (Japan Atomic Energy Research Inst., Tokyo). 1973. Translation of JAERI-Memo-4249. 22p. Dep. NTIS $3.25.

Columnar grains grow in sintered UO_2 pellets when heated under a temperature gradient at high temperature. The mechanism of the columnar grain growth is believed to be attributed to the migration of lenticular voids up to the central high-temperature region. This study, conducted using 95% T. D UO_2 pellets and incorporating parameters of heating power and heating time, revealed the columnar grain formation without any trace of lenticular voids. Based on the results obtained mainly by ceramography and x-ray diffraction, it is concluded that columnar grains can be formed by grain growth in a temperature gradient. The driving force for columnar grain growth is considered to be thermal stress as well as a decrease in grain-boundary energy. (auth)

27708 (AED-CONF-71-400, pp 75-84) EXPERIMENTS ON ELECTRON CHANNELING IN THE ENERGY RANGE FROM 5 TO 20 MeV. Harder, D. (Univ., Wuerzburg, Ger.); Bell, F. 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The channeling phenomena are discussed for multiply scattered electrons after passage through single crystals of MgO and Si. Within the energy range from 5 to 20 MeV, the phenomena can be explained equally well by the wave and the particle concepts. Both the experimental arrangement and the findings are presented. (5 figures) (HBG)

27709 (AED-CONF-71-400, pp 197-204) MONTE CARLO CALCULATIONS FOR THE SIMULATION OF ELECTRON AND POSITRON CHANNELING IN SINGLE CRYSTALS OF MgO. Schiebel, U. (Univ., Giessen, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

By means of Monte Carlo methods, the dependence of the number of transmitted particles on the orientation of the crystal is studied. The distributions of the impact parameters yield, in addition, the qualitative anisotropy of the bremsstrahlung intensity. (tr-auth)

27710 (ANL-8021, pp 15-17) VANADIUM PENTAFLUORIDE AND CARBIDES OF MOLYBDENUM AND VANADIUM. Johnson, G. K. Jul 1973.

In chemical engineering division thermochemical studies semiannual report, January-June 1973.

The thermodynamic properties of refractory carbides are basic data needed for understanding the chemistry of carbide fuel–fission product systems. A collaborative effort was undertaken with the Los Alamos Scientific Laboratory to determine the enthalpies of formation of the carbides of molybdenum and vanadium. Final calculations of the data from combustions of $MoC_{0.502}$ and $MoC_{0.851}$ in fluorine yielded the values $\Delta H_f^\circ(MoC_{0.502\pm0.004}, \alpha, 298.15°K)$ = –6.53 ± 0.73 kcal mol^{-1}, and $\Delta H_f^\circ(MoC_{0.851\pm0.004}, c, 298.15°K)$ = –5.13 ± 0.76 kcal mol^{-1}. Preliminary results from combustions of $VC_{0.847}$ in fluorine are $\Delta H_f^\circ(VC_{0.847\pm0.007}, c, 298.15°K)$ = ~–26 kcal mol^{-1}. An auxiliary datum needed to calculate this value was the enthalpy of formation of VF_5. Final calculations from combustions of vanadium metal in fluorine yielded $\Delta H_f^\circ(VF_5, g, 298.15°K)$ = –343.25 ± 0.20 kcal mol^{-1} and $\Delta H_f^\circ(VF_5, 1, 298.15°K)$ = –354.25 ± 0.28 kcal mol^{-1}. (auth)

27711 (BNWL-39) REACTOR AND MATERIALS TECHNOLOGY DEPARTMENT QUARTERLY REPORT ON TUNGSTEN–URANIUM DIOXIDE CERMET RESEARCH AND DEVELOPMENT ACTIVITIES, OCTOBER, NOVEMBER, DECEMBER 1964. (Battelle Northwest, Richland, Wash. Pacific Northwest Lab.). 1 Feb 1965. Contract AT(45-1)-1830. 109p. Dep. NTIS $7.50.

Declassified 9 Apr 1973.

Research and development activities in several areas of technology concerned with development of a W–UO_2 fueled, water-moderated, space propulsion reactor are summarized. Objectives of the programs related to the following: (1) basic behavior of W–UO_2 cermets; (2) tungsten fuel element design and fabrication; (3) cermet fuel fabrication studies; (4) cermet joining studies; (5) submicron dispersion of UO_2 and tungsten; and (6) nondestructive testing of cermet fuels. (LMT)

27712 (BNWL-110) REACTOR AND MATERIALS TECHNOLOGY DEPARTMENT QUARTERLY REPORT ON TUNGSTEN–URANIUM DIOXIDE CERMET RESEARCH AND DEVELOPMENT ACTIVITIES, JANUARY, FEBRUARY, MARCH 1965. deHalas, D. R. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1965. Contract AT(45-1)-1830. 268p. (NASA-CR-54409). Dep. NTIS $15.50.

Declassified 9 Apr 1973.

27713 (BNWL-SA-4732) NEUTRON IRRADIATION DAMAGE IN BORON CARBIDE. Kissinger, H. E.; Cummings, W. V.; Mahagin, D. E. (Battelle Pacific Northwest Labs., Richland, Wash; Westinghouse Hanford Co., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 19p. (CONF-730934-1). Dep. NTIS $3.00.

From 3rd international conference on x-ray and neutron small angle scattering; Grenoble, France (5 Sep 1973).

Small-angle x-ray scattering and transmission electron microscopy were used to characterize B_4C which was irradiated in EBR-II to 6×10^{20} to 17×10^{20} captures/cm^3 at 500 and 750°C. Pore-size distributions were estimated from the two methods and found to be in good agreement. (DLC)

27714 (CONF-731008-1) TRAPPING CENTERS AND ACTIVATORS IN THERMALOX BeO. Gammage, R. B. (Oak Ridge National Lab., Tenn.). 1973. 3p. Dep. NTIS $3.00.

From 4th international symposium on exoelectrons emission and dosimetry; Liblice, Czechoslovakia (1 Oct 1973).

Activators associated with thermally stimulated electron emission from ceramic BeO are of two types, one providing the electron and/or hole trapping site (primary activator), the other facilitating the release of detrapped electrons as exoelectrons. A paramagnetic center (hole trap) with axial symmetry and/or an Al^{2+} electron trap are the likely trapping sites from which the latent exoelectrons emerge. Silicon, lithium, and titanium are examples of secondary activators and they best facilitate the release of exoelectrons when they are in the form of beryllium compounds in the surface region. (auth)

27715 (HW-76304-A) CERAMICS RESEARCH AND DEVELOPMENT OPERATION QUARTERLY REPORT, OCTOBER–DECEMBER 1963. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 19 Mar 1964. Contract AT(45-1)-1530. 17p. Dep. NTIS $3.00.

Declassified 9 Apr 1973.

Results of research on properties and fabrication of cermet fuels are summarized. Information is included on thermal cycling, fabrication, and radiation effects testing of cermet fuels. Most results are associated with clad W–UO_2 fuel elements. Developmental programs devoted to ThO_2-base fuel elements are also described. Continuation of research on these materials is reported in the title-listed reports numbered HW–81600-A, HW–81601-A, BNWL–39, and BNWL–110. (JRD)

27716 (HW-81600-A) CERAMICS RESEARCH AND DEVELOPMENT OPERATION QUARTERLY REPORT, JANUARY–MARCH 1964. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 1964. Contract AT(45-1)-1350. 44p. Dep. NTIS $4.25.

Declassified 9 Apr 1973.

27717 (HW-81601-A) CERAMICS RESEARCH AND DEVELOPMENT OPERATION QUARTERLY REPORT, APRIL–JUNE 1964. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 1964. Contract AT(45-1)-1350. 39p. Dep. NTIS $4.00.

Declassified 9 Apr 1973.

For abstracts of individual papers see: 27719–27727, 27788, 27824, and 27825.

27718 (JPRS-59873) TECHNOLOGY OF PRODUCING NEW MATERIALS. 1972. Translation of Russian-Language Collection: Tekhnologiya Polucheniya Novykh Materialov. 109p. NTIS.

Twenty-one papers are presented on the physical properties and fabrication of carbides, ceramics, composites, borides, metals and alloys, cermets, and plastics. Separate abstracts were prepared for 12 of the papers. (DLC)

27719 (JPRS-59873, pp 1-3) EMISSIVITY OF ZIRCONIUM AND NIOBIUM CARBIDES IN THE REGION OF HOMOGENEITY. Okhremchuk, L. N.; Upadkhaya, G. S. 1972. Translated from pp 7-9 of Tekhnologiya Polucheniya Novykh Materialov.

The monochromatic coefficient ϵ_λ for λ = 655 microns was measured at ~1500°C for Ti, Nb, and Zr monocarbides in the C/M ratio range of 0.6 to 1.0. For TiC and ZrC, ϵ_λ increases slightly with C/M up to 0.8, remaining constant thereafter. The ϵ_λ of NbC is less than that of TiC or ZrC and has a minimum at C/M = 0.8. A model with localization of valence electrons is used to explain the results. (DLC)

27720 (JPRS-59873, pp 25-31) STUDY OF SINTERING KINETICS BY HOT EXTRUSION OF ZIRCONIUM AND TITANIUM CARBIDES IN REGIONS OF THEIR HOMOGENEITY. Naumenko, V. Ya.; Petrykina, R. Ya. 1972. Translated from pp 60-67 of Tekhnologiya Polucheniya Novykh Materialov.

Sintering kinetics were studied for hot extrusion of TiC_x and ZrC_x over the range x = 0.6 to 1.0. Density and activation energy were determined for various sintering times and x values. The activation energy increases with x. (DLC)

27721 (JPRS-59873, pp 32-36) HOT-PRESSING FEATURES OF MOLYBDENUM CARBIDE. Rogovoy, Yu. I.; Koval'chenko, M. S. 1972. Translated from pp 67-73 of Teknologiya Polucheniya Novykh Materialov.

The structure of Mo_2C (6.0% total c, 0.05% free c) was studied during hot pressing at 1900–2200°C. Results show that saturation of the surface with carbon from the graphite mold occurs; the composition of the outer layer is Mo_3C_2, with a hardness of 1200 to 1300 kg/mm^2. The formation of the surface diffusion layers hinders complete compaction during hot pressing. Increased temperature does not promote compaction but causes grain growth with formation of coarse pores. (DLC)

27722 (JPRS-59873, pp 42-47) PRODUCTION OF HIGHLY DISPERSED COPPER-BASE POWDER COMPOSITES CONTAINING REFRACTORY-METAL CARBIDES. Motyazhev, V. I. 1972. Translated from pp 79-84 of Tekhnologiya Polucheniya Novykh Materialov.

A study was made of the conditions for producing highly dispersed composite powders on a Cu base of 0.1 to 16 vol % TiC, ZrC, NbC, Cr_3C_2, Mo_2C, or WC, by H_2 reduction of basic copper carbonate. Completion of the reduction approached 100% when the temperature reached 150°C, and the addition of the dispersed carbide powder did not affect the reduction. Relations of specific surface and average particle size to carbide content are given. (DLC)

27723 (JPRS-59873, pp 48-52) PRODUCTION OF YTTRIUM-SUBGROUP RARE-EARTH METAL DODECABORIDES. Odintsov, V. V. 1972. Translated from pp 85-87 of Tekhnologiya Polucheniya Novykh Materialov.

The borothermal method of reduction of metal oxides by B in a vacuum, was used to synthesize the dodecaborides MB_{12} of Y, Dy, Ho, Er, Tm, and Lu. Excesses of 4 to 12% B were employed. (DLC)

27724 (JPRS-59873, pp 53-58) SINTERING TITANIUM DIBORIDE–MOLYBDENUM COMPACTS. Zaverukha, O. V. 1972. Translated from pp 93-98 of Tekhnologiya Polucheniya Novykh Materialov.

A mixture of Mo and TiB_2 powders were ground, mixed with a plasticizer, pressed, and sintered in vacuum. Changes in electric resistivity were used to indicate processes occurring during sintering. Relationships between the resistivity and the temperature, time, and shrinkage are discussed. It is concluded that it is possible to produce TiB_2–Mo parts with porosity <10% by sintering up to 2200°C. (DLC)

27725 (JPRS-59873, pp 88-94) INCREASING THE PHYSICAL AND MECHANICAL PROPERTIES OF CERMETS. Chaplygin, F. I. 1972. Translated from pp 159-166 of Tekhnologiya Polucheniya Novykh Materialov.

Characteristics of the three classes of hard cermet alloys are described: VK (WC-base), TK (WC–TiC-base), and TTK (WC–TiC–TaC-base). Elastic modulus and impact strength are discussed, and it is shown that the presence of three phases improves the properties of TK and TTK. The effects of the carbide constituent are discussed from the standpoint of its electronic structure; the properties of the cermet can be improved by alloying WC with metals and compounds which will increase its ductility while preserving or increasing its elasticity. 12 references. (DLC)

27726 (JPRS-59873, pp 100-105) INTERACTION OF TRANSITION METAL CARBIDES WITH SILICON. Kutysheva, E. V. 1972. Translated from pp 204-210 of Tekhnologiya Polucheniya Novykh Materialov.

The reactions of powders of $ZrC_{0.97}$, $NbC_{0.98}$, and $MoC_{0.48}$ with Si were studied at 800 to 1900°C. $ZrC_{0.97}$ starts to react at 800°C, $NbC_{0.98}$ at 1100°C, and $MoC_{0.48}$ at 1000°C. The reaction is: MeC +

$Si \rightarrow Me_x Si_y + \beta$-SiC. The stability of the carbides increases in this order: ZrC, Mo_2C, NbC. 5 tables. (DLC)

27727 (JPRS-59873, pp 813) ELECTRICAL RESISTANCE OF COMPOSITE MATERIALS. Petrova, E. M. 1972. Translated from pp 24-30 of Tekhnologiya Polucheniya Novykh Materialov.

The specific electrical resistance was measured as a function of porosity and metal content for the following systems (sintered at 1200°C): Fe–Mo_2C, Co–Mo_2C, Ni–Mo_2C, Fe–NbC, Co–NbC, and Ni–NbC. The resistance grows almost linearly with porosity, but the λ/λ_k –porosity relation is different for different materials, indicating interactions between components during sintering. (DLC)

27728 (N-71-35619) DEVELOPMENT OF A PLATINUM–THORIUM OXIDE ALLOY FOR RESISTOJET THRUSTER USE. Final Report. (Engelhard Minerals and Chemicals Corp., Newark, N.J. (USA). Engelhard Industries Div). Jul 1971. Contract NAS1-10433. 34p. (NASA-CR-111959). NTIS.

Stress-rupture testing showed a considerable increase in stress-rupture life for platinum–thoria alloys over the commercial platinum–rhodium alloys. Adding thoria to platinum at the 0.6% level has relatively little effect on the room-temperature mechanical and electrical properties. The principal effect of the thoria is to provide a stable, elongated grain structure, thereby improving the long-term, load-carrying capacity at elevated temperatures. Tubing was fabricated without difficulty from the platinum–0.6% thoria alloys. Joining tests were carried out by electron-beam welding, dap welding, diffusion bonding, spot welding, and high-temperature brazing. (auth)

27729 (NIIAR-P-173) X-RAY ANALYSIS OF RADIATION DAMAGE TO NONMETALLIC MATERIALS. Kosenkov, V. M. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 24p. (In Russian). INIS.

A brief review of the basic conclusions from the theoretical work on the scattering of x radiation on imperfect crystals is reported. The emphasis in this review is given to the qualitative change of the character of the scattering (appearance of quasi lines near the Bragg reflection) in the presence of large static distortions of the lattice. The possibility, in some cases, of making a quantitative evaluation of the concentration and dimensions of the defect clusters, using the Krivoglaz formula for specific types of defects, is shown. The presence in the irradiated crystals of several types of defects simultaneously hinders the interpretation of the x-ray effects. Approaches to the study of the radiation damage in nonmetallic materials are discussed for the example of beryllium oxide. (tr-auth)

27730 (SLA-73-5441) VARIABLE BIREFRINGENCE, LIGHT SCATTERING, AND SURFACE-DEFORMATION EFFECTS IN PLZT CERAMICS. Land, C. E. (Sandia Lab., Albuquerque, N. Mex.). 1973. 32p. (CONF-730933-1). Dep. NTIS $3.75.

From 3rd international meeting on ferroelectricity; Edinburgh, UK (10 Sep 1973).

A description is given of the several electrooptic effects of lead lanthanum zirconate titanate (PLZT) ceramics. Transverse and longitudinal electrooptic effects are covered. Work which leads to a better understanding of the effects is discussed. (5 figures, 23 references) (DLC)

27731 APPROXIMATE CALCULATIONS OF THE CHANGES IN ENTROPY AND ENTHALPY OF OXIDE COMPOSITIONS AT ELEVATED TEMPERATURES. Gorbunov, L. V. (Research Inst. for the Synthesis of Mineral Raw Materials, Aleksandrov, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 247(Feb 1973).

Translated from Zh. Fiz. Zhim. (USSR); 47: No. 2, 439-440(Feb 1973).

Increments for the approximation calculation of $S_T - S_{298}$ and $H_T - H_{298}$ of oxide compositions at temperatures up to 1400°K are proposed. Values are given for 24 compounds including B_2O_3, CdO, WO_3, and ZrO_2. (auth)

27732 GAS ETCHING: A NEW METHOD OF PRODUCING CONTRAST IN THE PREPARATION OF METALLOGRAPHIC SPECIMENS. I. Oxides, Oxide Cermets, and other Composites. Ondracek, G.; Spieler, K. (Kernforschungszentrum, Karlsruhe, Ger.). Prakt. Metallog.; 10: No. 6, 324-341(1973). (In German and English).

A new method of producing metallographic contrast is described using ionized gases as the etching reagent. The process is carried out in a gas-etching chamber, a prototype of which is already available. This is attached to a microscope stage so that the etching process can be observed directly as it occurs. The process is reproducible and controllable. The etching effect is based on color contrasts produced by layers of different thickness on the different phases. These layers are formed during the etching process by accumulation of gaseous ions on the specimen surface. Their structure can be controlled by the etching time, gas used and its pressure, current, voltage, and distance between the electrodes. The method can be used for multiphase metallic and nonmetallic materials. The examples discussed are poorly conducting materials such as oxides, oxide cermets, and other composites. The physical principle underlying the gas etching effect is interference at thin layers. Since the color contrasts can be explained in this way, the etching process is reproducible and controllable. Its application to quantitative structural analysis is also mentioned. (GE)

27733 SUPPRESSION OF AMOEBA EFFECTS IN COATED FUEL PARTICLES WITH CARBIDE KERNELS FOR HIGH-TEMPERATURE REACTORS. Naoumidis, A. (Kernforschungsanlage, Juelich, Ger.). J. Nucl. Mater.; 48: No. 2, 118-124(Sep 1973). (In German).

The coated fuel particles with UC_2 kernels can fail at temperatures above 1300°C under a temperature gradient due to an asymmetrical interaction between the kernel and coating material. Ways of stabilizing these kernels by doping are shown, based on theoretical considerations. Kernels with the compositions $U(C,N)_2$, U(C,N), and (U,Zr)(C,N) are proposed. Out-of-pile heat treatments demonstrate qualitatively but clearly that these dopings improve the properties of the coated fuel particles regarding suppression of the amoeba effect, and thus open possibilities for increasing gas-coolant temperatures in HTGCR's. 7 figures. (auth)

27734 THERMAL PRECIPITATION OF URANIUM DIOXIDE POWDERS FROM URANIUM(IV) OXIDE SOLS. Edenborough, B. W. (Univ. of New South Wales, Kensington, Australia); Malin, A. S.; Robins, R. G. J. Nucl. Mater.; 48: No. 2, 210-212(Sep 1973).

A UO_2 powder material less reactive to oxidation than UO_2 from conventional processes can be prepared by this heated sol process. Sols are prepared from uranyl salt solutions by H_2 reduction in the presence of a catalyst. UO_2 powder is precipitated by heating these sols at a controlled rate above 110°C and maintaining the temperature for a period of time. Electron micrographs showing the various stages in the development of the UO_2 particles are presented; they indicate that on heating the sols, there is a clustering process involving crystallites of cubic habit. (DLC)

27735 SOL-GEL PROCESS FOR PRODUCTION OF COMPACT MIXED OXIDES USED AS NUCLEAR FUELS. Halva, C. J.; Dewell, E. H. (to Babcock and Wilcox Co.). German Patent 1,646,406. 1 Feb 1973. 6p. (In German).

A process is described for production of dense mixed oxides for use as nuclear fuels. According to the sol–gel process, the colloids of thorium or uranium dioxide are prepared, then passed through a drying solution agent in droplets, where the droplets are obtained as gel in the form of spheres. A particular size of gel particle is chosen, and the impregnation process is begun in which the gel particles are brought into contact with uranyl or plutonyl nitrate solution having a specific concentration for a pre-determined length of time. For impregnation the gel particles run down a multistage liquid column through the uranyl or plutonyl solution into a separating liquid which terminates the contact and prevents conglomeration of the gel particles. The impregnated gel is made denser by calcination. (GE)

27736 STABILIZED ZIRCONIUM OXIDE AND ITS MANUFACTURING PROCESS. Pitts, F. (to Magnesium Elektron Ltd.). German Patent 2,231,539. 11 Jan 1973. 16p. (In German).

A process to produce stabilized zirconium oxide is characterized in that zirconium oxide and an yttrium oxide concentrate are mixed together, and the mixture is calcined for 1 to 10 hours at a temperature between 900 and 1500°C. The yttrium oxide concentrate used contains from 35 to 70% yttrium oxide and the remainder is mainly of heavy or light rare earth metal oxides and which is a sufficient amount for a yield of at least 3 mole % yttrium oxide plus heavy rare earth metals. The stabilized zirconium oxide can be used to form bodies by grinding it in the presence of water and then pressing it into the desired shape under a pressure of 784 kg/cm^2 and the form obtained is then sintered for 2 hours at a temperature between 1400 and 1650°C. Experimental results show that the use of yttrium oxide/oxides of rare earth concentrates as stabilizing agent, results in a higher stability of the zirconium oxide bodies with a higher sintering density than can be obtained by using 99.9% pure yttrium oxide alone as stabilizing agent. (GE)

27737 PREPARATION METHOD FOR SPHERICAL, URANIUM OXIDE CONTAINING PARTICLES SUITABLE FOR NUCLEAR FUEL PRODUCTION. Swanson, R. E. (to Minnesota Mining and Mfg. Co.). German Patent 1,467,344. 4 Jan 1973. 7p. (In German).

A process is described for the preparation of spherically formed uranium-oxide-containing particles suitable for nuclear fuels. A smelt is prepared consisting of a fusible solvated uranium salt

(e.g., hydrated uranium nitrate) on its own or with the addition of up to some 15 wt % finely divided carbon or up to about 50% nuclear fuel components (e.g., a finely divided thorium compound, insoluble in the solvent). The smelt is dispersed into almost spherical particles having a diameter of some 10 to 500 μ in an inert liquid, and a solidification of the smelted particles in spherical form of the particles is brought about. The solidified particles are heated to a temperature below the melting point of these, and the hydration water is removed and the existing uranium salt is converted into uranium trioxide. (GE)

27738 SELECTIVE DISSOLUTION OF POWDERED PHASES USING A SPECIAL ANODE CELL AND ACOUSTICAL VIBRATION. Isobe, S. (Daido Steel Co., Nagoya, Japan); Newkirk, J. B.; Yukawa, N. pp 39-47 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

An electrolytic method is described in which attempts are made to selectively dissolve individual phases from a mixture of powdered intermetallic and carbide phases. A novel anode cell is described, in which a mixture of graphite powder plus the powdered specimen is contained. Liquid and electrical communication to the outside of the cell is maintained during potentiostatic dissolution, through a porous paper membrane. It is shown by diffractometer traces, made of the anode powder mixture before and after potentiostatic dissolution, that selective dissolution is usually, though not always, obtained. The application of acoustical vibration during the electrolysis treatment promotes more effective dissolution. (auth)

27739 IMPROVED ZIRCONIUM DIOXIDE POWDERS, MANUFACTURING PROCESS, AND USES. Woodhead, J. L. (to United Kingdom Atomic Energy Authority). German Patent 2,232,259. 11 Jan 1973. 13p. (In German).

A zirconium dioxide powder is described that is suitable for polishing glass, with a crystal-like average size of 100 to 1500 Å. The preparation process of this oxide from zirconium hydroxide using a sol–gel method with various modifications is also described. By means of spray-drying spherical particles are prepared which are sintered at a temperature between 900 and 1200°C forming zirconium dioxide powder. (GE)

27740 DEVICE FOR THE PRECIPITATION OF LAYERS MADE OF PYROLYTIC CARBON. Hackstein, H. (to NUKEM Nuklear Chemie and Metallurgie GmbH. German Patent 1,934,554. 21 Jan 1971. Filed date 8 Jul 1969. (In German).

A device is described for precipitation of layers of pyrolytic carbon and silicon on particles of nuclear fuel and fertile material, by decomposition of gaseous compounds. It is characterized by the fact that precipitation takes place in a whirling layer, whereas the intake of gaseous substances by a tube has the effect of separating the zone of coating from the zone of reaction. (tr-auth)

27741 CARBURIZATION AND DECARBURIZATION OF NIOBIUM AND TANTALUM. Hoerz, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metall; 27: No. 7, 680-687(1973). (In German).

Results of a survey on new investigations in the niobium–carbon and tantalum–carbon systems are presented. The reactions of methane and acetylene with niobium and tantalum at temperatures above 1500°C and hydrocarbon pressures below 10^{-1} torr are discussed individually. In particular, the change of the electrical resistance of niobium and tantalum due to the uptake of carbon, the mechanisms and the kinetics of the carbon reactions, and the solubility of carbon in niobium and tantalum are dealt with. The mechanism and the kinetics of the decarburization of niobium and tantalum in a stream of oxygen by formation and release of carbon dioxide are discussed. Some practical applications from the results obtained are dealt with. The state diagrams for the systems V–C, Nb–C and Ta–C are compiled. (16 figures, 5 tables, 31 references) (GE)

27742 FABARICATION OF MOLDED ARTICLES MADE OF ARTIFICIAL GRAPHITE OR MATERIALS SIMILAR TO ARTIFICIAL GRAPHITE. Luhleich, H.; Nickel, H.; Dias, F. (to Kernforschungsanlage Juelich GmbH). German Patent 2,133,044. 18 Jan 1973. 7p. (In German).

A process is described for manufacturing molded articles from artificial graphite or materials similar to artificial graphite for fillers incorporating synthetic resin as a binding medium. The thus-formed slurries can be poured or put directly into molds as liquid or wet mass or can be shaped as a kneadable mass. Following two other procedures, the slurries are dried and the powder formed is then stirred with a liquid mixture, in which the binding medium is not soluble, or only in small amounts or swells, such as e.g., water. Using a mold or another means of shaping, it is formed—or the powder is put directly into the desired shape and finally subjected to the liquid vapors in which the binding medium is partly or wholly soluble. Then it is dried and coked by a known way. The process claim is thus characterized that the binding medium part in the slurry used is greater than 25 wt %. (GE)

27743 GRAIN GROWTH OF URANIUM CARBIDE WITHIN TEMPERATURE RANGES OF 1,500 TO 1,900°C. Erben, E. (EURATOM, Ispra, Italy). Metall; 27: No. 7, 693-695(1973). (In German).

Results are presented of investigations on the grain growth of electron-beam-melted UC having a carbon content of 4.65 and 4.88 wt % in the temperature range of 1500 to 1900°C, at test times of ½ to 24 hours. Whereas at 1500°C, for all three compositions only a relatively small grain growth occurred, at 1700 and 1900°C a considerable grain growth was observed, where in any case the greatest grain growth was exhibited by the substoichiometric uranium monocarbide, whereas the values for stoichiometric or superstoichiometric uranium monocarbide did not differ significantly. The activation energies for the range 1500 to 1700°C for all three compositions investigated are of the same order as that for the self-diffusion of carbon and uranium in uranium monocarbide, whereas in the range 1700 to 1900°C only, the substoichiometric uranium monocarbides exhibit this value. The values for the stoichiometric of superstoichiometric uranium monocarbide, however, are only ¼ of the activation energies for the self-diffusion. (GE)

27744 AMBIENT STRENGTH AND FRACTURE OF ZrO_2. Rice, R. W.; McDonough, W. J. (Naval Research Lab., Washington, DC). pp 394-403 of Mechanical Behavior of Materials. Vol. IV. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P4.

Room-temperature strengths of most ZrO_2 bodies (corrected for porosity effects) increase with the inverse square root of the grain size at rates that indicate a flaw size smaller than the grain size. Strengths of most bodies, to a first approximation, do not depend on the stabilizer except through the stabilizer's effect on porosity and grain size. Less than full stabilization can result in either weak or strong bodies, depending on the resulting microstructure. A change in failure mechanism, possibly to a microplastic mechanism, occurs at the finer grain sizes. In some specimens, large pores appear to act as stress concentrators rather than flaws. Fracture topography variations with body parameters are in agreement with surface energy estimates of 5 to 25 J/m^2. (auth)

27745 EFFECTS OF DENSITY AND GRAIN SIZE ON THE ELASTIC AND PIEZOELECTRIC PROPERTIES OF $Pb(ZrTi)O_3$ CERAMICS. Okazaki, K.; Nagata, K. (Defense Academy, Yokosuka, Japan). pp 404-412 of Mechanical Behavior of Materials. Vol. IV. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P4.

The hot-pressing technique was applied for piezoelectric ceramics of the Pb $(Zr_{0.51}Ti_{0.49})$ +1 wt % MnO_2 system. A group of specimens of controlled density with a constant grain size and a group of specimens of controlled grain size with a constant density were successfully fabricated by selected hot-pressing conditions. For each group, electrical, piezoelectric, and elastic constants and mechanical strength were systematically examined as functions of the volume fraction porosity p or the grain size G_s, respectively. The effect of p or G_s on each constant X was expressed by a simple equation $X = X_0 \exp(ap)$ or $X = X_1 G_s^b$, respectively, and the empirical constants X_0, a, X_1 and b were determined for all measured constants. 14 figures. (auth)

27746 ELECTRICAL CONDUCTIVITY OF UO_2–ThO_2 SOLID SOLUTIONS. Lee, H. M. (Univ. of Toronto). J. Nucl. Mater.; 48: No. 2, 107-117(Sep 1973).

The electrical conductivities of UO_{2+x}, ThO_2, and their solid solutions, in thermodynamic equilibrium with the gas phase, were measured as a function of temperature, and of oxygen partial pressure in the temperature range 800 to 1200°C. The slope of the plot log σ versus 1/T for UO_{2+x} and UO_2-rich solid solutions exhibits two regions. The pressure dependence of the conductivity (σ) in the UO_2-rich solid solutions can be represented by $\sigma \propto [O_i] \propto P_{O_2}^{1/6}$ in the range of $0.01 < x < 0.1$. Here, O_i is an interstitial oxygen and P_{O_2} the partial pressure of oxygen, and it varies with the ThO_2 content. At greater deviation from stoichiometry ($x \geq 0.1$), the presence of U_4O_9 or $(ThU)_4O_9$ phases influences the conductivity data. In ThO_2 or ThO_2-rich solid solutions, P-type conduction at high oxygen pressures is interpreted as arising from the incorporation of excess oxygen into oxygen vacancies. (auth)

For abstracts of individual papers see: 27748–27750, 27842, and 27889.

27747 MECHANICAL BEHAVIOR OF MATERIALS. Volume V. Composites; Testing and Evaluation. Proceedings of the

International Conference, Kyoto, Japan, August 15–20, 1971. Kyoto; Society of Materials Science (1972). 550p. (CONF-710851-P5).

28 papers are concerned with the mechanical behavior of various composite materials (fiber-reinforced and laminated). 23 papers discuss testing and evaluation of materials (x-ray stress analysis, hardness, Moire fringe, ultrasonic, welds, etc.). Separate abstracts were prepared for five papers. (DLC)

27748 MECHANICAL BEHAVIOR OF WC–Co COMPOSITE ALLOYS. Doi, H. (Mitsubishi Metal Corp., Omiya, Japan); Fujiwara, Y.; Oosawa, Y. pp 207-219 of Mechanical Behavior of Materials. Vol. V. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P5.

Tensile and compressive tests of WC–Co alloys were carried out in regard to the effect of microstructure and carbon content. Recovery of internal friction and the 0.2% proof stress were also investigated. It was found that although the stress–strain curves for the initial deformation stage coincide with each other for tensile and compressive loading, fracture strength, ductility, and their dependence on mean free path and carbon content greatly differ from one another. Furthermore, in the recovery process of the alloys, dislocation annihilations in the binder phase occur and the presence of WC particles considerably retards the recovery. Mechanisms of deformation and fracture were briefly discussed. (8 figures, 17 references) (auth)

27749 MECHANICAL BEHAVIOR OF WC–STEEL ALLOYS. Hara, A.; Yazu, S. (Sumitomo Electric Industries Co., Ltd., Itami, Japan). pp 242-249 of Mechanical Behavior of Materials. Vol. V. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P5.

The effect of the strength of the matrix metal on the mechanical behavior of cemented carbides was investigated. WC–high strength steel alloys were prepared and the compressive strength and transverse rupture strength were measured. The elastic limit of the alloys is considerably higher than that of the conventional WC–Co alloys. It is further shown that the elastic limit of both alloys is a linear function of the reciprocal square root of the spacing of dispersed particles. Curves representing transverse rupture strength vs mean free path were also obtained. (11 figures) (auth)

27750 NEW METHOD FOR EVALUATING THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS. Fukui, T.; Kato, T.; Nakamura, Y.; Morishita, T. (Asahi Glass Co., Ltd., Yokohama, Japan). pp 380-389 of Mechanical Behavior of Materials. Vol V. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P5.

A new technique for evaluating thermal shock resistance of ceramic materials is proposed. An apparatus was designed for thermal shock tests under conditions simulating the thermal cyclings to which heater bed materials are subjected in the rotary type regenerators of MHD power plants. Using this apparatus, perforated blocks of sintered electro-fused magnesia were tested and their thermal shock resistance was confirmed to be good. In addition, some analytical treatments were made by a computer to estimate the effect of the shapes, dimensions, and physical properties of perforated block on thermal shock resistance. (auth)

27751 THEORETICAL ASPECTS IN SPINODAL DECOMPOSITION AND CRYSTALLIZATION OF SILICATE MELTS: EXPERIMENTAL RESULTS FOR THE UO_2–SiO_2 SYSTEM. Lungu, S.; Beleuta, I. L.; Apostol, D.; Radulescu, O. (Inst. for Atomic Physics, Bucharest). J. Nucl. Matèr.; 48: No. 2, 165-171(Sep 1973).

The primary crystallization of quenched melts, in which the changes in composition involve the crossing of spinodal curves, is analysed. It is shown that the normal primary crystallization could be practically stopped when the temperature of the melt becomes lower than the temperature at which the corresponding liquidus concentration is lower than the corresponding spinodal concentration. Experimental results are presented on the volume fraction and dimension of primary UO_2 crystal and spinodal decomposition widths (wavelength) for the UO_2–SiO_2 melts quenched by injection in copper and stainless steel moulds. The experimental data confirm the possibility of primary crystallization stopping at 2070°C which is the invariant point of the UO_2–SiO_2 system. The mean dimensions of UO_2 primary crystals depend on the rate of quenching as exponential $-1/6$. A similar "weak" dependence on the quenching rate was obtained for the spinodal decomposition wavelength. (auth)

27752 VOIDS IN BORON CARBIDE. Ashbee, K. H. G. (Univ. of Bristol, Eng.); Frank, F. C.; DuBose, C. K. H. J. Nucl. Mater.; 48: No. 2, 193-198(Sep 1973).

Two different void morphologies were observed in the commercial grades of boron carbide that are currently undergoing assessment as candidates for the control rod material in fast breeder reactors. Some grains in unirradiated powders contain dodecahedral voids which are closely associated with iron-rich precipitates believed to be cementite, and neutron-irradiated powders also contain plate-shaped voids oriented parallel to {110} planes (rhombohedral indices). These latter voids are believed to contain fission gas and their plate-like morphology is attributed to work which the gas can do in elastically deforming the matrix if their shape is changed from spherical to disc-shape. (auth)

27753 STRUCTURES AND PHASE RELATIONS OF Al-SUBSTITUTED $SmCo_5$, $PrCo_5$, Sm_2Co_{17}, AND Pr_2Co_{17}. Oesterreicher, H. (Oregon Graduate Center, Beaverton). J. Less Common Metals; 32: No. 3, 385-388(Sep 1973).

The phase relations were investigaed to determine properties of materials with potential for use in permanent magnets. Experimental data on structures and lattice parameters of these compounds with Al being accommodated and substituting for part of the Co atoms are tabulated. The effects of the Al–Co relations are discussed for each compound. (JRD)

27754 REACTIONS OF THE PLATINUM-GROUP METALS WITH CARBIDES OF THE 4th AND 5th GROUP OF THE PERIODIC TABLE DURING SINTERING AND MELTING. Raub, E.; Falkenburg, G. (Forschungsinstitut fuer Edelmetalle und Metallchemie, Schwaebisch Gmuend, Ger.). Metall; 27: No. 7, 669-679(1973). (In German).

An investigation is described in which the ternary systems Ru–Ti–C, Ru–Ta–C, Ru–V–C, and Pt–Ti–C are reacted with the monocarbides of Ti, Ta, and V. Furthermore, the reactions of Rh and Ir with the monocarbides of Ti, V, Nb and Ta are followed. (GE)

27755 SLOW CRACK GROWTH IN PROTON– AND DEUTERON–IRRADIATED QUARTZ. Williams, J S.; Lawn, B. R. (Univ. of New South Wales, Kensington, Australia). J. Mater. Sci.; 8: No. 7, 1059-1061(Jul 1973).

It is known that cracks in silicates can grow subcritically in the presence of a chemically reactive external environment. It is suggested that analogous crack growth can be caused by migration of an active chemical species within the material. Observations are reported of slow crack growth in irradiated quartz. A possible sequence of events is: (1) dissociation of hydrogen atoms from the irradiated lattice, (2) stress-enhanced diffusion of hydrogen atoms to crack tip, and (3) reaction of atomic hydrogen with stressed crack-tip bonds. (UK)

27756 EFFECT OF FISSION-FRAGMENT IRRADIATION UPON THE PASSIVE OXIDATION OF SILICON-BONDED SILICON CARBIDE BY OXYGEN AT 950°C. Bennett, M. J.; Chaffey, G. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 48: No. 2, 131-138(Sep 1973).

The effect of fission fragment irradiation on the passive oxidation of a silicon-bonded silicon carbide by oxygen was examined at 950°C. The fission fragment flux ranged between 6.3 and 12.2×10^{10} ff/cm^2 · s, and the exposure period varied up to 4768 h. The extent of oxidation was increased slightly by the fission recoil bombardment. The enhancement was more significant during the initial exposure (≤500 h), when it was increased by a factor of between 2.5 to 3.5. Subsequently, the factor became progressively decreased to 1.6 to 1.9 after 4768 h. Comparison between the extents of oxidation of the silicon carbide and free silicon constituents suggest that it was the oxidation of free silicon which was increased, particularly over the initial exposure period. Thereafter, silica film growth on both components was enhanced to comparable extents. The most probable mechanism for the continuing radiation-induced attack was that the silica film properties controlling oxidation were influenced by chemical contamination with fission products and uranium oxide ejected from the sources with the emerging fission fragments. (6 figures) (auth)

27757 THERMAL-GRADIENT MIGRATION OF HELIUM BUBBLES IN URANIUM DIOXIDE. Buescher, B. J.; Meyer, R. O. (Argonne National Lab., IL). J. Nucl. Mater.; 48: No. 2, 143-156(Sep 1973).

The migration velocities of cyclotron-injected helium bubbles were measured in single-crystal UO_2 in a measured linear temperature gradient of approximately 1000°C/cm. At temperatures around 2000°C, bubble velocities on the order of 1 μm/h are observed independent of bubble size for radii in the range of 100 Å to 1 μm. These velocities do not agree with predictions made from existing simple theories of pore migration, and a new surface-gas mechanism is proposed based on nonlocalized surface diffusion. The proposed mechanism predicts bubble velocities independent of bubble size in the size range observed, but other mechanisms are believed to be applicable for small (< 100 Å)

and large (> 1 μm) bubbles. Results from a number of related measurements are summarized, and a comparison of isothermally measured bubble mobilities is made using the concept of a bubble-diffusion coefficient. (8 figures, 3 tables, 41 references) (auth)

27758 FISSION-ENHANCED SELF-DIFFUSION OF URANIUM IN UO_2 AND UC. Hoeh, A.; Matzke, H. (EURATOM, Karlsruhe, Ger.). J. Nucl. Mater.; 48: No. 2, 157-164(Sep 1973).

In-pile self-diffusion measurements in stoichiometric UO_2 sinters and single crystals and in arc-cast stoichiometric UC were performed using the thin-layer condition and ^{233}U as tracer. The nominal irradiation temperature was 900°C. The resulting diffusion coefficients D* of 1.5×10^{-16} $cm^2 \cdot s^{-1}$ for UO_2 and 2.2×10^{-17} $cm^2 \cdot s^{-1}$ for UC for a fission rate $\dot{S}$ of $1 \times 10^{13} f/cm^3 \cdot s$ represent radiation-enhanced diffusion and are higher by factors of 10^3 to 10^4 than (extrapolated) coefficients of thermal diffusion. The data are of immediate relevance for understanding and predicting such important quantities as in-pile sintering and densification, diffusion-controlled creep, and fission-gas behavior in the outer zones of the fuel. They are at the upper limit of expected values. (18 references) (auth)

27759 PRODUCTION OF A FUEL CARBIDE WITH A JACKET OF FUEL NITRIDE, SULFIDE, OR PHOSPHIDE. Krauth, H. A. K.; Mueller, N.; Himmelstein, P. (to Nukem Nuklear Chemie und-Metallurgie). U. S. Patent 3,753,854. 21 Aug 1973. Filed date 15 Jun 1970. 6p.

Nuclear fuel particles are prepared by forming a jacket of 1- to 10-μm-thick uranium, plutonium, or thorium nitride, sulfide, or phosphide on fuel carbide particles having a size between 0.01 and 2 mm. (Official Gazette)

27760 SINTERED MOLYBDENUM–BORON ALLOY. Benesovsky, F. (to Schwarzkopf Development Corp.). U. S. Patent 3,753,703. 21 Aug 1973. Priority date 11 Oct 1968, Austria. 6p.

A description is presented of a sintered molybdenum boron alloy optionally containing other additives including tungsten, zirconium, and hafnium with the boron content of the alloy being less than about 0.2 weight per cent and preferably between 0.005 and 0.01 weight per cent. (Official Gazette)

27761 EFFECT OF ABRASION RESISTANCE AND THERMAL PROPERTIES OF THE CEMENTED CARBIDE CUTTING TOOL GRADE ON THE FLANK WEAR CHARACTERISTICS. Ber, A. (Technion–Israel Inst. of Tech., Haifa). J. Eng. Ind.; 3: No. 3, 794-796(Aug 1973).

Correlation of the wear characteristics with abrasion resistance factor—(1/vol. loss) in a standard test—was established in a low speed range where the temperatures involved in the cutting action are relatively low. It was found that a lower abrasion resistance factor produced, (in specified time and cutting conditions except speed, which was a variable), higher flank wear at a range of low speeds—20 to 100 SFPM or 6 to 35 per min—but, when speed is increased, other properties than abrasion resistance are involved, i.e., hot hardness characteristics and thermal conductivity coefficient are able to withstand higher velocities. Speed versus thermal conductivity coefficient curve was established where the cutting time and flank wear levels were constant. Feed and depth of cut were also constants. The investigation results demonstrated that thermal conductivity coefficient of the cutting-grade material is very significant and plays a major role in its ability to resist transfer of heat from the cutting zone to the flank of the tool, and thus no reduction of hardness due to temperature. This phenomenon results in the ability of the tool to perform in high-speed range. (auth)

27762 METHOD OF PREPARING UNIFORM SIZE POWDERS. Hill, H. W.; Marlowe, M. O.; Kaznoff, A. I. (to United States Atomic Energy Commission). U. S. Patent 3,752,872. 14 Aug 1973. Filed date 26 Aug 1971. 4p.

A method for preparing inorganic powders consisting of particles of uniform controlled size in the range 0.2 to 40 microns is described. The procedure utilizes isostatic forming and high temperature sintering to form grains of the desired size. The compact then is disintegrated by cyclic oxidation-reduction to separate the grains along grain boundaries thus preserving the identity of the grains. These grains form the particles of the new powder. The procedure is applicable to UO_2 or other compounds of multivalent cations. (AEC)

27763 STABILIZED URANIUM OR URANIUM–PLUTONIUM NITRIDE FUEL. Leitnaker, J. M.; Spear, K. E. II. (to United States Atomic Energy Commission). US Patent 3,746,616. 17 Jul 1973. Filed date 23 Dec 1969. 6p.

A high-temperature fuel is provided comprising an oxygen-containing uranium or uranium–plutonium mononitride which forms a separate U–O–N phase under reactor service conditions, wherein the nitrogen equilibrium pressure is at least a factor of 20 less than that of the corresponding oxygen-free mononitride fuel. Stabilization of these fuels with respect to nitrogen release is achieved by incorporating an amount of oxygen in the fuel and reacting the fuel under reactor service conditions to form the U–O–N phase which accommodates within the structure excess nitrogen as it is produced from fuel burnup. (AEC)

27764 APPARATUS FOR THE HOMOGENIZATION AND MIXING OF NUCLEAR FUELS. Pirk, H.; Ploeger, F.; Vietzke, H. (to Nuken Nuklear-Chemie und- Metallurgie, GmbH). US Patent 3,746,312. 17 Jul 1973. Filed date 23 Jun 1969. 4p.

An apparatus for mixing and homogenizing ^{235}U- or plutonium-containing nuclear fuels is provided. It comprises a vertical, flat rectangular container which is either rotatable about a horizontal middle axis or is a fluidized bed. The apparatus has filter candles to separate exit gases from solids. (Official Gazette)

27765 RANGE DISTRIBUTION OF IMPLANTED IONS IN SiO_2, Si_3N_4, AND Al_2O_3. Chu, W. K.; Crowder, B. L.; Mayer, J. W.; Ziegler, J. F. (IBM Watson Research Center, Yorktown Heights, NY). Appl. Phys. Lett.; 22: No. 10, 490-492(15 May 1973).

Backscattering measurements with 2.0-MeV He^+ ions were used to determine the range distribution of Zn, Ga, As, Se, Cd, and Te implanted in SiO_2, Si_3N_4, and Al_2O_3 at energies between 150 and 300 keV. Values of the projected range were systematically greater than LSS predictions by factors of 1.2 to 1.5. In normalized LSS units, the projected range, ρ_p, as a function of energy, ϵ, consistently followed within experimental error the relation $\rho_p = 2.7\epsilon$, where an arithmetic average atomic number of 10 and arithmetic average atomic mass of 20 apply to all three target species. (auth)

27766 NIOBIUM CARBIDE PRODUCTION BY THE DIFFUSION SATURATION OF GRAPHITE. Gal, V. V.; Nikitin, K. A.; Pavlov, Yu. A.; Savinov, V. K.; Skachkova, T. M. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 117-120(1973). (In Russian).

The process of the production of niobium carbide by the continuous diffusion saturation of graphite was studied. The results showed that the continuous diffusion saturation of graphite granules (0.6 to 0.8 mm), using porous graphite of type PG-50, and $NbCl_5$ can be reached at temperatures higher than 2400°C and sustained approximately 10 hr. (JSR)

27767 STRUCTURE OF URANIUM AND MOLYBDENUM DOUBLE OXIDES. Serezhkin, V. N.; Kovba, L. M.; Trunov, V. K. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 210: No. 5, 1106-1109(11 Jun 1973). (In Russian).

The literature data on a number of U and Mo double oxides are reviewed. Single crystals of β-UMo_2O_8, $UMo_{10}O_{32}$ and of α-, β-, and γ-$U_3Mo_{20}O_{64}$ were x-rayed, and the intensities of the 448, 640, 345 and 286 independent reflections were estimated. An analysis of the three-dimensional distributions of interatomic functions confirmed the arrangement of metal atoms in these compounds, and allowed certain conclusions on the possible variations in position for the U and Mo atoms. The characteristic element in the structure of these double oxides are infinite layers of the composition Mo_2O_7, which propagate perpendicular to the c period. Layers are formed by octahedra of MoO_6 united with each other by five common peaks. The "thickness" of each layer corresponds to two octahedra having a common peak. Between the Mo_2O_7 layers in all compounds are atoms of uranium, molybdenum and oxygen which are connected in metal–oxygen chains propagating parallel to the a period. Six or four oxygen atoms from neighboring Mo_2O_7 layers enter the coordination sphere of each uranium and molybdenum atom found between the layers, as a result of which the coordination figure of the uranium atoms is a hexagonal bipyramid, while that of the molybdenum atoms is an octahedron. The U–O distance in uranium–oxygen chains is equal to 2.06 to 2.08 Å in uranium oxygen compounds including the reviewed double oxides. The structures of these double oxides are very similar. (tr-auth)

27768 X-RAY ABSORPTION K SPECTRA OF ZIRCONIUM IN ITS COMPOUNDS WITH ELEMENTS OF THE SECOND PERIOD OF THE PERIODIC SYSTEM. Petrov, E. V. (Inst. of Mining and Metallurgy, Frunze, USSR). Metallofizika; No. 44, 83-88(1973). (In Russian).

Absorption K-spectra were obtained on an x-ray spectrograph for the following compounds of zirconium: ZrF_4, ZrO_2, ZrN, ZrC, ZrB_2, and a solid solution of zirconium in beryllium (2 wt % Zr). Exposure was carried out on the second order of reflection from the $(11\bar{2}2)$ plane of the quartz crystal bent along a radius of 860 mm. Calculations were made on the fine structure of the spectra in the region to 200 eV from the K-absorption edge. The theory

of close order was made the basis of the calculations. The mean free path of the electron freed as a result of the act of absorption was estimated. It is shown that in the series of zirconium compounds with the elements from beryllium to fluorine, the mean free path of the electron decreases from 4.8 to 2 Å. (tr-auth)

27769 INFLUENCE OF ORDER–DISORDER TRANSFORMATIONS ON THE ELECTRICAL RESISTIVITY OF VANADIUM CARBIDE. Shacklette, L. W.; Williams, W. S. (Univ. of Illinois, Urbana). AT(11-1)-1198. Phys. Rev., B; 7: No. 12, 5041-5053 (15 Jun 1973).

The electrical resistivity of single crystals of vanadium carbide was studied as a function of composition and temperature. Particular attention was devoted to the resistivity of the two ordered phases of vanadium carbide, V_6C_5 and V_8C_7. Both solids are shown to undergo first-order transformations to the disordered state at elevated temperature. Results were used to assess the role of carbon vacancies in determining the resistivity of the disordered solids. Vacancy scattering accounts for over 90% of the residual resistivity (resistivity at liquid-He temperatures) of the disordered solids but reduces in importance as temperature increases. The change in the resistivity of V_6C_5 at its critical point was found to be 5.4 ± 0.3 μΩ cm or (3.6 ± 0.2)% of the total resistivity of the disordered solid. The corresponding change found for V_8C_7 was 20.1 ± 1.4 μΩ cm or (14.7 ± 1.0)%. The critical temperatures for disordering in the two ordered phases were determined to be (1275 ± 8)°C for V_6C_5 and (1124 ± 15)°C for V_8C_7. The vanadium–carbon system was also shown to have a strong preference for one or the other of the ordered phases for nearly all compositions in the range $0.83 \leq x \leq 0.90$, where x is the carbon-to-metal ratio. (16 figures, 3 tables, 32 references) (auth)

27770 RECOMBINATION DOMAIN INSTABILITY IN HIGH-ENERGY-ELECTRON-IRRADIATED GERMANIUM. Wada, T. (Mie Univ., Tsu, Japan); Fukuoka, Y.; Arizumi, T. Jap. J. Appl. Phys.; 11: No. 7, 1009-1015(Jul 1972).

When a bar of *n*-type germanium (1 ~ 2 Ω-cm) is irradiated with a total flux of about 10^{15} to 10^{16} electrons/cm² at 8.5 MeV, domains of high electric field in the irradiated crystal appear at a high field above 350 V/cm and 77°K. At sufficiently high electric fields, current–voltage characteristics, estimated by observing an instantaneous current density and a time constant associated with the trapping of hot electrons at defect centers, have a voltage-controlled differential negative resistance region. So the high-field domain is formed by the buildup of the space charge boundaries. The velocity of moving domains ranged from 10^5 to 2×10^6 cm/s, depending on the light intensity. (auth)

27771 INTENSITY OF CHARGED-PARTICLE RECOMBINATION ON THE SURFACE OF SOME REFRACTORY-METAL BORIDES IN WEAKLY IONIZED HYDROGEN PLASMA. Mel'nik, V. M.; Lavrenko, V. A.; Kuznetsova, L. I. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 7, 83-85(Jul 1973). (In Russian).

The relative intensity of the recombination of charged particles—hydrogen ions and electrons—on the surfaces of zirconium, niobium, and tungsten borides was investigated by means of the cyclotron resonance method. The intensity of the charged-particle recombination is greatest near the NbB_2 surface; W_2B_5 is characterized by the lowest intensity of recombination. (auth)

27772 GRINDING OF POWDERS IN THE PLANETARY CENTRIFUGAL MILL. II. Some Grinding Relationships. Matsera, V. E.; Pugin, V. S.; Strashinskaya, L. V.; Dobrovol'skii, A. G.; Nikitin, Yu. I.; Pogorelyi, B. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 7, 11-17(Jul 1973). (In Russian).

Optimal conditions are determined for grinding refractory metal-like compounds in the planetary mill permitting powders with a specific surface of 40–50 m^2/cm^3 to be obtained, the iron admixture in grinding being 3 vol %. The ability of materials to be ground in the planetary centrifugal mill (PCM) increases regularly with an increase in their E, G, H_μ, and brittleness. The admixture grinding is explained to a considerable extent by the abrasive ability of powders. Grinding in the PCM cannot be applied to crush plastic materials having a tendency to setting because of the particle agglomeration. Materials for which grinding data are given include TiC, ZrC, TiB_2, ZrB_2, CrB_2, $MoSi_2$, TiN, W, Mo, and Ni. 5 figures, 4 tables, 15 references. (auth)

27773 CREEP DURING HOT PRESSING OF TITANIUM DIBORIDE POWDER. Koval'chenko, M. S.; Mai, M. M. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 23-27(Aug 1973). (In Russian).

The hot pressing process is studied for titanium diboride powders with different iron contents. It is shown that this process is controlled by the process of steady-state creep, and the reduced creep rate is proportional to the cube and 4th power of pressure for TiB_2 powder of technical purity and with an admixture of 1.8% Fe, respectively. An essential rise in the compaction rate grain growth as well as a decrease in the activation energy and cessation of compaction at the late stage of hot pressing are established when the iron content in the TiB_2 powder rises. (auth)

27774 OBTAINING POWDERS OF ZIRCONIUM AND HAFNIUM SULFIDES. Kaminskii, B. T.; Prokof'eva, G. N.; Plygunov, A. S.; Galitskii, P. A. (Kiev Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 7, 6-10(Jul 1973). (In Russian).

Interaction of zirconium and hafnium oxides with hydrogen sulfide and mixtures of the former with carbon (the molar ratio oxide: carbon being 1:2) at 500 to 1300°C as well as ZrO_2 and HfO_2 interaction with carbon bisulfide within a temperature range of 500 to 1400°C was studied by chemical and x-ray phase analyses. Zirconium and hafnium disulfides close to the stoichiometric composition and uniphase ones are formed only during sulfidization of these oxides with carbon bisulphide at 1300 to 1400°C. The lattice parameters and pycnometric density of zirconium and hafnium disulfides were determined. (4 tables) (auth)

27775 MECHANISM OF ELECTRIC EROSION OF COMPOSITE MATERIALS DURING ELECTROSPARK ALLOYING. Verkhoturov, A. D.; Murzin, L. M. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 94-99(Aug 1973). (In Russian).

Problems are considered in the erosion resistance of the anode material with electrospark alloying, the anode being made of the IV-group metal carbides with additives. An experimental dependence is obtained of erosion on the content of metal binder in carbides. The article deals with the theoretical problems of the metal-binder effect on the erosion resistance in composition materials (in the aspect of a change in the destruction mechanism of cermets with different content of the metal binder). Data are presented for ZrC–Ni, NbC–Ni, ZrC–Fe, NbC–Fe, NbC–Co, and ZrC–Co. (auth)

27776 APPLICATION OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO STUDIES OF TEXTURE. Sharp, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceram. Soc.; No. 20, 27-41(Jun 1972).

Conventional 100-kV transmission electron microscopy is an important technique for studies of the microstructure of materials, but unfortunately thin specimens (a few thousand Å) are required. Suitable ceramic specimens are very difficult to prepare and hence the increased penetration available with higher accelerating voltages is particularly useful. A second important advantage is the reduced spherical aberration at high voltages, which results in a considerable increase in the accuracy of the selected-area diffraction technique, and high-resolution dark-field micrographs can be obtained simply by displacing the objective aperture. High-voltage electrons have sufficient energy to displace atoms in many specimens, producing radiation damage. These features are discussed in detail and illustrated with results obtained on the Harwell 1 MV microscope. (auth)

27777 SOLID-SOLUTION FORMATION IN UO_2–ThO_2 SYSTEM. Ashok, M.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Ceram. Soc.; 30: No. 5, 124-132(Sep 1971).

An x-ray diffraction study was made of solid solution formation in UO_2–ThO_2 system which has a significant effect on the densification behavior of oxide mixtures. Various aspects such as shifting of diffraction lines, influence of temperature, composition, sinterability of relative rates of diffusion, etc., on solid solution formation (50/50 mixture) are described in detail. D values for thorium oxide are tabulated which help to follow the initial stages of solid solution formation. Results indicate that UO_2 can go into the lattice of ThO_2 with greater ease than vice versa. Lattice parameters of UO_2–ThO_2 solid solutions are also determined. (INIS)

27778 MOLYBDENUM–RHENIUM NITRIDE. Savitskii, E. M.; Tylkina, M. A.; Tsyganova, I. A.; Kuz'ma, Yu. B. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 446-447(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 498-499(Mar 1973).

Nitridation of Mo–47% Re alloy was carried out at 1050°C in NH_3 vapor. X-ray diffraction shows that the 20-30 μ layer has a Mo-base solid solution, Re, and a fcc phase (a = 4.125 Å). This new fcc phase is probably $(Mo, Re)_2N$; the composition may be $Mo_{1.76}Re_{0.24}N$. (DLC)

27779 EXPERIMENTAL DETERMINATION OF THE HIGH-TEMPERATURE SPECIFIC HEAT OF β–BN. Kiseleva, I. A.; Mel'chakova, L. V.; Topor, N. D. (Moscow State Univ.). Inorg.

Mater. (USSR) (Engl. Transl.); 9: No. 3, 442-443(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 494-495(Mar 1973).

The specific heat was determined at 298 to 1000°K by the mixing method. The enthalpy follows the equation $H_T - H_{298} = 7.67T + 1.74 \times 10^{-3}T^2 + 4.73 \times 10^{+5}T^{-1} - 4030$. The specific heat equation is $C_P = 7.67 + 3.48 \times 10^{-3}T - 4.73 \times 10^{5}T^{-2}$. (DLC)

27780 PHASE EQUILIBRIA IN SYSTEMS Dy_2O_3-CaO, Y_2O_3-CaO, AND Yb_2O_3-CaO. Lopato, L. M.; Gerasimyuk, G. I.; Shevchenko, A. V.; Tresvyatskii, S. G. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 380-383(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 427-431(Mar 1973).

Phase relations at 1400 to 2400°C in the systems Dy_2O_3-CaO, Y_2O_3-CaO, and Yb_2O_3-CaO were investigated and phase diagrams constructed. Characteristic features of these systems are: 1) formation of $CaLn_4O_7$ compounds (Ln=Dy, Y, Yb), $CaLn_2O_4$ (Ln = Dy, Y, Yb), $Ca_3Ln_2O_6$ (Ln = Y, Yb), $Ca_2Ln_2O_5$ (Ln = Yb); b) formation of solid solutions based on calcium oxide and various polymorphic forms of rare earth oxides; c) a reduction in the phase transition temperatures of rare earth oxides in the presence of calcium oxide. (auth)

27781 SPECTROSCOPIC INVESTIGATION OF POLYMORPHOUS FORMS OF Eu_2O_3. Valtere, A. Ya.; Bondar, I. A.; Ovsyankin, V. V. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 366-369(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 413-416(Mar 1973).

An investigation was made of the absorption spectra of the cubic and monoclinic modifications of europium oxide. Interrelation of the structural and spectroscopic properties was made. It was shown that the phase transition passes through a stage of polysynthetic twinning. (auth)

27782 SYSTEMS VANADIUM-IRON-BORON, VANADIUM-COBALT-BORON, AND VANADIUM-NICKEL-BORON. Kuz'ma, Yu. B.; Starodub, P. K. (Lvov State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 337-340(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 376-381(Mar 1973).

Using x-ray structural and microstructural analysis, the systems V-{Fe, Co. Ni}-B were investigated and isothermal cross sections were constructed at 800°C. An investigation of a single crystal revealed that the compound $VCoB_3$ has an orthorhombic structure (V_2B_3-type superlattice structure); a = 3.04 ± 0.01 Å, b = 17.55 ± 0.03 Å, and c = 2.98 ± 0.01 Å. (5 figures) (auth)

27783 APPLICABILITY OF THE DEBYE-WALLER FACTOR TO THE He SCATTERING FROM METAL SURFACES. Comsa, G. (Univ., Bonn). J. Phys., C (London); 6: No. 17, 2648-2652(4 Sep 1973).

The Debye-Waller factor has been calculated for specularly reflected He beams by taking into consideration the normal component of the incident atom velocity in addition to the influence of the attractive potential well suggested by Beeby (J. Phys. C: Solid St. Phys.; 4: L359-62(1971)). The calculated figures are, in most cases, too small to correspond to the experimental values of the reflected intensities. The apparent low thermal roughness of the surface is discussed. (auth)

27784 THERMOLUMINESCENCE, EPR SPECTRA, AND OPTICAL ABSORPTION OF SILICATE GLASSES AFTER IRRADIATION BY X RAYS. Taylor, K. N. R.; Shul'gin, B. V.; Hunt, R. P. (Univ. of Durham, Eng.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 416-419(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 470-474(Mar 1973).

Measurements were made of the thermoluminescence, EPR spectra, and optical absorption of x-ray-irradiated sodium silicate and lithium aluminosilicate glasses activated by rare earths. The nature of the defects responsible for these phenomena is mainly associated with nonbridging oxygen atoms in silicon-oxygen octahedra. Increasing the titanium content of the specimens quenches the thermostimulated luminescence and stabilizes the defects in the glass due to x-ray irradiation. (auth)

27785 EPITAXIAL IRON GARNET FILMS WITH SUBMICRON DIAMETER MAGNETIC BUBBLES. Giess, E. A.; Guerci, C. F.; Kuptsis, J. D.; Hu, H. L. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). Mater. Res. Bull.; 8: No. 9, 1061-1066(Sep 1973).

Mixed-rare-earth iron garnet compositions were developed in the form of epitaxial films which support submicron diameter magnetic bubbles. $Sm_{0.75}Yb_{2.25}Fe_5O_{12}$, $Eu_{0.9}Yb_{2.1}Fe_5O_{12}$, and $Eu_{1.2}Lu_{1.8}Fe_5O_{12}$ films on (111) $Gd_3Ga_5O_{12}$ as well as $Sm_{1.5}Yb_{1.5}Fe_5O_{12}$ and $Eu_{1.7}Yb_{1.3}Fe_5O_{12}$ films on (111) $Sm_3Ga_5O_{12}$ can be grown by an isothermal liquid phase epitaxy method. The effects of growth conditions on film composition and the lattice mismatch between a film and its substrate are discussed. (auth)

27786 THERMODYNAMIC PROPERTIES OF NON-STOICHIOMETRIC ZIRCONIUM DIOXIDE IN THE 1173 TO 1373°K TEMPERATURE RANGE. Gerasimov, Ya. I.; Vasil'eva, I. A.; Granovskaya, Zh. V.; Maiorova, A. F. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 210: No. 6, 1347-1349(21 Jun 1973). (In Russian).

Zirconium dioxide exists in three different modifications: monoclinic below 1373°K, tetragonal from 1373 to 2573°K, and cubic from 2573 to the melting temperature of 2973°K. Thermodynamic data on the monoclinic modification of nonstoichiometric zirconium dioxide do not exist, and were determined in this study at temperatures of 1173 to 1373°K by taking emf measurements of ZrO_{2-x} samples in contact with a solid electrolyte. Values of x were 0.003, 0.004, 0.006, 0.007, 0.008, and 0.012; the error in x was $\pm 1 \times 10^{-3}$. Values of ΔH, ΔS, and ΔG are given for various values of x at minimum, average, and maximum temperatures. Values of ΔH and ΔS decrease sharply with deviation from the stoichiometric composition of ZrO_2. Discussion of the defect structure of nonstoichiometric zirconium dioxide will be published later. (SJR)

Metals and Alloys

Refer also to abstracts 29266, 29539, 29541, and 29569.

Corrosion and Erosion

Refer also to abstracts 27778, 29194, 29217, and 29554.

27787 (AD-755385) EFFECT OF A THIN DIFFUSED SOLUTE LAYER ON THE NUCLEATION OF FATIGUE CRACKS. Progress Report, 1 October 1971-1 October 1972. Greenfield, I. G.; Snyder, D. M. (Delaware Univ., Newark (USA). Dept. of Mechanical and Aerospace Engineering). Dec 1972. 58p. (AFOSR-TR-73-123). NTIS.

Small alterations in the surface conditions of Ti-6Al-4V can have significant effects on the fatigue life. A critical amount of dissolved oxygen near the surface was more effective than diffused aluminum. A combination of solute hardening, twin formation, and grain-boundary effects seems, at this time, to be the major controlling factor in the surface retardation of the nucleation of fatigue cracks. High vacuum will increase fatigue life greatly. The lifetime in high vacuum appears to be due to the growth of the cracks and not the nucleation process. (NTIS)

27788 (JPRS-59873, pp 66-70) SOLID-PHASE INTERACTION OF MOLYBDENUM AND TUNGSTEN DISILICIDES WITH Ti AND Zr IN AN ELECTRON-BEAM HEATER. Yurchenko, O. S. 1972. Translated from pp 129-134 of Tekhnologiya Polucheniya Novykh Materialov.

An electron-beam heating unit was used to heat pressed couples of Ti or Zr with $MoSi_2$ or WSi_2, to 900 to 1300°C for 1 h. Diffusion zones were detected in all the systems, but an unusual rapid growth of the diffusion zone from 1 micron at 1200°C to 19 microns at 1300°C in the WSi_2/Ti system was observed. WSi_2 is recommended for alloying with Zr-base alloys. (DLC)

27789 ANALYSIS OF ACOUSTIC EMISSION PRODUCED DURING STRESS-CORROSION CRACKING OF U-10 wt. % Mo ALLOY. Bedere, D.; Miannay, D. (Centre d'Etudes de Bruyeres le-Chatel, Montrouge, France). J. Nucl. Mater.; 48: No. 2, 183-192(Sep 1973). (In French).

The acoustic emission accompanying stress-corrosion cracking in air, at ambient temperature, of a U-10 wt% Mo alloy was investigated by a counting technique. The acoustic output is due to the plasticity and microcracking which accompany macroscopic cracking. The output increases slightly in the course of a test and is not a unique function of the stress intensity factor. The practical interest of this method for nondestructive testing is discussed. (17 figures) (auth)

27790 SPECTROPHOTOMETRIC STUDY OF PRODUCTS FORMED DURING OXIDATION OF TITANIUM AND TA6V ALLOY. Renaud, M. (Ecole Nationale Superieure d'Electrochimie et 'Electrometallurgie, Grenoble, France); Rigaud, M. J. Less-Common Metals; 32: No. 3, 371-378(Sep 1973). (In French).

The products formed during the oxidation of titanium and TA6V alloy between 400 and 650°C have been studied by diffuse reflectance spectra. Oxides of the general formula Ti_nO_{2n-1} are formed, with n varying with time of exposure. The oxide TiO (n = 1) is always present in contact with the metallic phase and oxides with greater values of n may be present in the gaseous phase. The value of n for the surface oxide increases with the thickness of the oxide film. When this film becomes sufficiently thick, the surface oxide is rutile, TiO_2. (auth)

27791 MOLYBDENUM SINTERING AND THE MOLYBDENUM–OXYGEN–CARBON SYSTEM. Young, W. S. (IBM System Products Div., Hopewell Junction, NY). J. Less-Common Metals; 32: No. 3, 321-330(Sep 1973).

The sintering properties and chemical stability of molybdenum in the presence of an organic binder and a reducing atmosphere were studied. The effect of atmosphere and particle size is shown. Phase diagrams are used to explain the formation of Mo_2C, Mo, or MoO_2 as a function of the sintering atmosphere used. (auth)

27792 EXPERIMENTAL AND THEORETICAL STUDY OF ELECTRO-EROSION OF METALS. Guerrero Alvarez, J. L. Urbana, IL; Univ. of Illinois (1972). 191p. University Microfilms Order No. 73-17,233. Thesis (Ph. D.).

Single electrical discharges were produced on 13 electrode materials (Al, Cr, Cu, Fe, Mg, Mo, Nb, Ni, Ta, Ti, V, W, and Zn) under conditions similar to electro discharge machining (EDM). Primary consideration was given to Fe and Zn with kerosene as the dielectric, however additional studies were made with both dry and liquid nitrogen as the dielectric. A topographical technique was developed to measure the volume of metal removed per unit of applied electrical energy, thus allowing a quantitative analysis of the electro-erosion phenomenon. For kerosene, all metals studied except Nb, Mo, and Ta exhibited a larger cathode than anode crater volume. When either dry or liquid nitrogen was used, the anode crater volume was larger. The morphology and surface texture of the electro-erosion craters were studied as a function of the applied electrical energy by means of scanning electron microscopy, transmission microscopy, and topographical techniques. (JRD)

27793 REFRACTORY METAL ALLOYS FOR USE IN OXIDATION ENVIRONMENTS. Anderson, W. T. Jr.; Mendelson, R. A. (to TRW Inc.). U. S. Patent 3,753,699. 21 Aug 1973. Filed date 30 Dec 1971. 2p.

A refractory-metal alloy comprising principally niobium and titanium with lesser amounts of hafnium, vanadium, tungsten, aluminum, and molybdenum provides excellent resistance to air oxidation at high temperature. The preferred composition range is as follows: niobium 48 to 54%; titanium 23 to 25%; hafnium 9.75 to 17.5%; vanadium 2 to 8.75%; tungsten 2.25 to 2.75%; aluminum 1.8%; and molybdenum 0.7%; all parts by weight. (Official Gazette)

For an abstract of an individual paper see: 29194.

27794 DEPOSITION AND CORROSION IN GAS TURBINES. Proceedings of an International Conference, London, England, December 6–7, 1972. Hart, A. B.; Cutler, A. J. B. (eds.). London; Applied Science Publishers Ltd. (1973). 428p.

Twenty-two papers were presented with special emphasis on laboratory and experimental rig studies of corrosion under operating conditions and the assessment of commercial alloys for gas turbine applications. Some aspects of the development of new corrosion-resistant alloys are also described. Also included are chemical reactions of the fuel and air impurities during combustion and the aerodynamic factors which influence the depositions of the combustion residues, and industrial experience with land-based and marine gas turbines and the procedures which have been established for successful operation. One paper, on the surface reactions of HTR helium with turbine materials and their influence on creep behaviour, was in NSA scope; a separate abstract was prepared for it. (UK)

27795 STUDY OF PROCESS OF OXIDATION IN ZIRCONIUM–OXYGEN ALLOYS. Korobkov, I. I. Izv. Akad. Nauk SSSR, Metal.; No. 3, 110-115(1973). (In Russian).

Zirconium–oxygen alloys were made by oxidizing iodide zirconium in pure oxygen at 1400 to 1500°C until a black film of the necessary thickness formed on the metal, followed by melting of the oxidized samples in an arc furnace with a tungsten electrode. The Zr–O alloys contained 0.1, 5.8, 7.3, 9.8, 17, 21.6, and 29 at. % oxygen. After melting, the alloys were subjected to a homogenizing annealing at 850°C for 250 h in an evacuated quartz tube filled with shavings of a Zr + 8% Ti alloy. Microstructural and x-ray analyses showed that all the alloys had a single-phase structure with an average grain size of 0.1 to 0.2 mm. Microcracks were noted in alloys containing 17% oxygen and higher. The data on the kinetics of oxidation of the Zr–O alloys at 500 and 800°C showed that the dissolved oxygen led to an increase in the rate of oxidation of zirconium. Up to 5 at. % oxygen, the oxidation rate increases only slightly. From 5 to 10 at. % oxygen, the oxidation rate increases sharply, and at higher oxygen content, falls off somewhat. The oxidation rate is a function of oxygen pressure for zirconium containing oxygen. In the oxide films, along with monoclinic ZrO_2, a finely crystalline cubic modification is present whose amount increases with increasing oxygen content in the alloy. At 800°C, the diffusion mobility of oxygen in the zirconium decreases, if the initial alloy contains more than 10 at. % oxygen. (SJR)

27796 NITRIDES AND OXIDES FORMED ON THE SURFACE OF NIOBIUM IN VACUUM AT HIGH TEMPERATURES. Umanskii, Ya. S.; Ageev, M. N.; Lein, F. Ya.; Ermankova, M. P.; Pavlov, E. E. (Inst. of Steel and Alloys, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 3, 341-343(Mar 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 3, 382-384(Mar 1973).

X-ray structural analysis was used to investigate the phase composition of the products of reaction of Nb with O_2 and N_2 at 400 to 1200°C. Results show that the oxide phase of niobium has a uniform composition, but oxidation acquires a protective character on formation of a continuous film of NbO. The reaction of niobium with nitrogen at low pressures leads to formation of Nb_5N_6 with a hexagonal lattice, described for the first time by Terao. (auth)

27797 PROCESS OF PREVENTING NITRIDATION OF STEEL SUBMERGED IN LIQUID SODIUM. Fischer, A. K. (to United States Atomic Energy Commission). U. S. Patent 3,745,068. 10 Jul 1973. Filed date 21 Sep 1971. 4p.

A process was given for preventing nitridation of steel submerged in liquid sodium, especially the stainless steel components of nuclear reactors submerged in liquid sodium coolant. An effective amount of calcium or magnesium was added to the liquid sodium for reacting with nitrogen carriers present in the sodium or with the sodium impurities that form such carriers whereby nitrogen is prevented from being carried to the stainless steel. (auth)

27798 COATINGS FOR COLUMBIUM AND COLUMBIUM-BASE ALLOYS. Reznik, B. D. (to United States Atomic Energy Commission). U. S. Patent 3,753,763. 21 Aug 1973. Filed date 24 Jan 1964. 6p.

A method of protectively coating columbium and columbium-base substrates for service at temperatures above 2000°F is given. The substrate spray coated with a slurry consisting of a powdered mixture of silicon, aluminum, and silver in a lacquer followed by diffusion treating the coated substrate in an inert atmosphere at a temperature in the range of 1900 to 2300°F. A layer of silicide intermetallic compounds adjacent the substrate and a layer of silver-silicon-aluminum alloy overlaying the first layer are formed. (Official Gazette)

Preparation and Fabrication

Refer also to abstracts 27171, 27579, 27718, 27909, 29462, 29466, 29467, and 29550.

27799 (N-72-27577) ELECTROLYTIC PROCESS FOR ULTRAFINE BERYLLIUM. Final Report. Lidman, W. G.; Griffiths, V. (Kawecki Berylco Industries, Inc., Reading, Pa. (USA)). 30 Jun 1972. Contract NASw-1844. 14p. (NASA-CR-127427). NTIS.

Studies were made on the electrolysis of a molten $BeCl_2$–NaCl bath using a mercury cathode and beryllium anode. A quasi-amalgam was obtained. The beryllium was consolidated by direct hot pressing of the amalgam at temperatures in the range of 800°C and using pressures of 5,000, 10,000, and 20,000 psi. The work confirms the ability to produce ultrafine beryllium particles by electrolysis. (auth)

27800 (N-73-13512) PURIFICATION KINETICS OF BERYLLIUM DURING VACUUM-INDUCTION MELTING. Mukherjee, J. L. (Grumman Aerospace Corp., Bethpage, N. Y. (USA)). Oct. 1972. Contract NAS8-27891. 22p. (NASA-CR-123946; RM-553). NTIS.

The kinetics of evaporation in binary alloys were quantitatively examined. The formalism so developed works well for several systems studied. The kinetics of purification of beryllium was studied through evaporation data actually acquired during vacuum induction melting. Normal evaporation equations are shown to be generally valid and useful for understanding the kinetics of beryllium purification. The normal evaporation analysis has been extended to cover cases of limited liquid diffusion. It was shown that under steady-state evaporation, the solute concentration near the surface may be up to six orders of magnitude different from the bulk concentration. Corrections for limited liquid diffusion are definitely needed for the highly evaporative solute elements, such as Zn, Mg, and Na, for which the computed evaporation times are improved by five orders of magnitude. The commonly observed logarithmic relation between evaporation time and final concentration further supports the validity of the normal evaporation equations. (auth)

27801 (ORNL-4874) DEVELOPMENT AND CONSTRUCTION OF A MOLYBDENUM TEST STAND. DiStefano, J. R.; Moorhead, A. J. (Comps.) (Oak Ridge National Lab., Tenn.). Dec 1972.

Contract W-7405-eng-26. 60p. Dep. NTIS $5.45.

Mo is promising as a containment material for a process that uses liquid bismuth at 500 to 700°C to remove protactinium and fission products from the molten salt fuel of a breeder reactor. Low-C, low O Mo prepared by arc casting was chosen as the structural material for a reductive-extraction test loop that would be representative of typical equipment. Final design was determined after fabrication and joining technique development. Procedures were developed for the production of closed-end molybdenum half sections by back extrusion. Parts that were generally free from cracks and had high-quality surfaces were produced by the use of ZrO_2-coated plungers and dies and extrusion blank preheat temperatures of 1600 to 1700°C. It was found that molybdenum tubing with improved ductility could be produced by careful removal of contamination introduced during tubing fabrication. Complex components were fabricated by welding, using either the gas tungsten-arc or electron-beam process. Welding studies centered on three major types of joint: tube-to-tube, tube-to-header, and header-to-header. Two of the most important factors found to minimize weld hot cracking were stress relieving and preheating of components prior to welding. Mechanical bonding techniques were developed to join small-diameter tubing to back-extruded end sections. Experiments carried out at 250°C in an argon atmosphere produced helium-leaktight joints. Brazing filler metals were developed that are reasonably corrosion resistant to bismuth and molten salt up to 700°C. Techniques involving induction or resistance heating were developed to braze the several types of joints used in the test stand. The MSR Program was terminated before construction of the test stand was completed, but an unjoined mockup using molybdenum components was assembled, and detailed assembly procedures were worked out. All of the techniques required for final assembly were demonstrated. (37 figures) (auth)

27802 EFFECT OF A MAGNETIC FIELD ON A TITANIUM ALLOY WELD STRUCTURE. Gel'fgat, Yu. M.; Gurevich, S. M.; Kompan, Ya. Yu.; Mikel'son, A. E.; Novikov, Yu. K. Magn. Gidrodin.; No. 2, 155-157(1973). (In Russian).

It was shown that as a result of the interaction of the weld variable current with the constant magnetic field the oscillating motions of the melt at the boundary of the solid–liquid phase leads to improvement of the crystalline structure of the sample and increase of the weld coefficient. The effect appears narrower at field induction values of 0.06 T. (tr-auth)

27803 POSSIBLE REINFORCEMENT OF THE TUNGSTEN–NICKEL–IRON COMPOSITE WITH TUNGSTEN FIBERS. Zukas, E. G.; Eash, D. T. (Los Alamos Scientific Lab., NM). J. Less-Common Metals; 32: No. 3, 345-353(Sep 1973).

Tungsten wire fibers were added to the liquid-phase-sintered heavy alloy (W–Ni–Fe) composite in an attempt to improve its low-temperature strength and ductility. The as-drawn tungsten fibers, which can have strengths exceeding 400,000 psi (281 kg/mm^2), were dissolved during the sintering process, whereas fibers that had been given a prior recrystallization anneal above the sintering temperature were not dissolved. Thus, the dissolution behavior of fiber additions is not governed solely by surface energy considerations but by the total energy content of the particles. (auth)

27804 SHOCK-WAVE SYNTHESIS AND CHARACTERIZATION OF Nb_3Sn. Otto, G. H. (Univ. of Alabama, Huntsville); Roy, U.; Reece, O. Y. J. Less-Common Metals; 32: No. 3, 355-364(Sep 1973).

The synthesis of Nb_3Sn, a hard superconductor, was accomplished by the use of a converging shock-wave arrangement. The irreversible phase formation for stoichiometric and non-stoichiometric powder mixtures was studied by changing the shock-wave intensity. Evidence of compound formation was obtained by quantitative metallography, microhardness, x-ray diffraction, and superconductivity measurements. It is concluded that tin, owing to its high compressibility and low specific heat, acts as the main source of heat while the use of powder materials favors ready achievement of the reaction temperature. The same procedure, when applied to the formation of the isostructural Nb_3Al phase, resulted in $NbAl_3$ instead. (auth)

27805 LATTICE PARAMETERS OF COMPOUNDS OF THE TYPE $RE(Zn)_5$ HAVING THE $CaCu_5$ ($D2_d$) STRUCTURE. Green, M. L. (Bell Telephone Labs., Murray Hill, NJ). J. Less Common Metals; 32: No. 3, 391-394(Sep 1973).

$RE(Zn)_5$ compounds, where RE = Ce, Pr, Nd, Sm, Gd, Dy, or Er were prepared for use in determining if they form hexagonal compounds of the $CaCu_5$ ($D2_d$) type. Data on interplanar spacings and intensities are tabulated for these compounds along with crystallographic data. These data are analyzed. (JRD)

27806 EFFECTS OF WARM WORK ON SOME MECHANICAL AND FABRICATION PROPERTIES OF URANIUM. Hughes, A. N.; Lane, R. A.; Orman, S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater.; 48: No. 2, 172-182(Sep 1973).

Uranium plates were warm rolled at 250°C to reductions of up to 90%. Subsequent tensile tests at ambient temperature showed a progressive increase in fracture stress and ductility with increased deformation. No evidence of anisotropy in tensile properties was observed for material unidirectionally rolled to 80% reduction at 250°C. Cupping tests were performed on 0.048-in. (1.2 mm) uranium sheet warm rolled up to 90% reduction. Tests were made at room temperature and 200°C on both the as-rolled and the annealed conditions. Values of $\bar{R}$, the average width strain to thickness strain ratio, were determined during the tensile tests. No correlation was observed between the determined limiting drawing ratios and $\bar{R}$ values. However, good cupping behavior was shown to be a characteristic of material with a high tensile ductility. (6 tables, 8 figures, 17 references) (auth)

27807 CRACKING IN WELDED JOINTS. Occurrence and Prevention in Nuclear Plant. Dickinson, F. S.; Watkins, B. Weld. Metal. Fabr.; 41: No. 9, 329-335(Sep 1973).

In the nuclear industry, weld-cracking problems have occurred during the fabrication of chemical process plant for uranium purification and for fuel reprocessing, both of which involve the use of nitric acid, and also in the fabrication of various components for nuclear reactors and associated facilities. Some of the problems associated with the construction of the chemical plant which are discussed are: hot-cracking in the weld metal of stainless steels, heat-affected zone cracking on reheating particularly with Nb-containing stainless steel, and HAZ cracking arising from grain growth in Ni–Cu alloys. The importance of nondestructive test methods, their evaluation, and the development of new techniques in weld testing of carbon steels for pressure vessels and for vanadium-bearing and boron-bearing low-alloy steels are discussed. (UK)

27808 HIGH-MELTING METALS AND NEW APPLICATIONS. Palme, R. Metall; 27: No. 7, 724-728(1973). (In German).

A report is given on the possible uses of metals with good high-temperature properties such as tungsten, molybdenum, and tantalum. Some of the possibilities given are the use in high-temperature oven buildings (radiation safety screens, heat conductors, charging plates, and combustion boats), as a container for the evaporation of metallic and chemical substances in high vacuum, in fusion metallurgy, in hot-working techniques, in the chemical industry, as electrode materials for electroerosion, and as nonvibrating tool shanks. (GE)

27809 PROCESS FOR PROVIDING A HYDRIDE-FREE AND OXIDE-FREE SURFACE ON ZIRCONIUM AND ZIRCONIUM-ALLOY BODIES. Griggs, B. (to United States Atomic Energy Commission). U. S. Patent 3,753,883. 21 Aug 1973. Filed date 26 Jun 1972. 6p.

A zirconium or zirconium-alloy body having a zirconium hydride surface layer is electrolytically anodized in aqueous nitric acid solution to remove the hydride surface. Fluoride ions are then added to the solution and electrolytic anodization is continued. Chemical etching of the specimen using HNO_3–HF solution provides a hydride-free and oxide-free surface. Chemical etching may be in situ employing the anodization bath as etchant if the concentration of fluoride ions is high– or a separate etchant solution may be employed. (Official Gazette)

27810 RECOVERY, PROPERTIES, AND APPLICATIONS OF TIN AND OF THE RARER METALS GALLIUM, INDIUM, SELENIUM, TELLURIUM, BISMUTH, NIOBIUM, AND TANTALUM. Van der planken, J. (Kawecki-Billiton N. V., Arnhem, Netherlands). Chem. Ztg.; 97: No. 6, 331-336(1973). (In German).

The recovery, properties, and applications of high-purity gallium, indium, selenium, tellurium, tin, bismuth, niobium, and tantalum are reviewed. Possible tendencies and trends in new applications are also mentioned. In addition, for each element, scientific problems or technical difficulties important for potential applications, are briefly discussed. (89 references) (GE)

27811 USE OF FLOATING-ZONE MELTING TECHNIQUE FOR THE GROWTH OF NIOBIUM BICRYSTALS. Pande, C. S.; Lin, L. S.; Butler, S. R.; Chou, Y. T. (Lehigh Univ., Bethelem, PA). J. Cryst. Growth; 19: No. 3, 209-210(Jun 1973).

A method of growing bicrystals of high-melting-point bcc metals using a floating-zone technique is described. The method utilizes a special seeding procedure in which a Y-shaped seed for the bicrystal is made from a partially split single crystal. Large niobium bicrystals of specified orientations (0.63 cm in diameter and over 10 cm in length) have been grown by this method. (auth)

27812 GROWTH OF InBi SINGLE CRYSTALS. Walter, H. U. (Univ. of Alabama, Huntsville). J. Cryst. Growth; 19: No. 4, 351-355(Jul 1973).

Large single crystals (up to 20 cm length and 4 cm diameter) of InBi were grown by hard and soft mold Bridgman, Czochralski, and horizontal boat techniques. The crystals were characterized in terms of subgrain mis-orientation and dislocation densities. Dislocation densities were determined by etching in a Br_2/methanol solution. Crystals of highest structural perfection with no observable subgrains and dislocation densities of $0.5 - 2 \times 10^4/cm^2$ were obtained by the Czochralski technique with seeds oriented along ⟨hkO⟩ and pulling rates of 3 to 4 cm/hour. Self-nucleated crystals grow rather exclusively with the c-axis perpendicular within 10 degrees to the growth direction. (auth)

27813 CHANGE IN SPECIFIC SURFACE OF TUNGSTEN AND MOLYBDENUM OXIDES IN THE REDUCTION PROCESS. Savin, A. V.; Chizhikov, D. M.; Tsvetkov, Yu. V.; Mel'nik, Yu. I.; Deineka, S. S.; Muzaleva, V. V. (Inst. of Metallurgy, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 5-9(Aug 1973). (In Russian).

Hydrogen reduction kinetics under the intensive rate of the process inhibiting stabilization of particles during heating is studied as affected by initial dispersity of oxides. It was observed that of all the tungsten and molybdenum oxides tungsten dioxide has the most pronounced ability to stabilization during heating and hydrogen reduction at 800 to 1030°C. Acceleration of reduction within this temperature range was observed on high-dispersed powders consisting of the mixture oxide and metallic particles. Separation of oxide particles by neutral admixtures causes a decrease in sizes of the formed metallic powder and acceleration of the reduction process. (auth)

27814 PECULIARITIES IN COLD AND HOT MOLDING BY SUPERHIGH PRESSURES OF SINTERED MOLYBDENUM. Baturin, V. E.; Klebanov, Yu. D.; Rozanov, B. V.; Sumarokov, V. N. (All Union Research Inst. for Metallurgical Machine Building, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 10-14(Aug 1973). (In Russian).

The influence of cold and hot (to 800°C) treatment by superhigh pressures (to 60 kbar) was studied as applied to density, microhardness, and structures of sintered molybdenum. The influence of vacuum thermal treatment on the mechanical properties of the molybdenum compacted samples was also investigated. The effect of powdery molybdenum strain hardening was detected by x-ray analysis; the value of microstresses was established in the samples treated with superhigh pressures. (auth)

27815 PRESSING AND SINTERING OF FINELY DISPERSED MOLYBDENUM POWDER. Sukhozhak, V. V.; Panichkina, V. V.; Skorohod, V. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 20-22(Aug 1973). (In Russian).

Some physicochemical properties, moldability, and sinterability of molybdenum powder obtained during catalytic reduction of molybdenum trioxide were studied. The powder is shown to possess a developed specific surface (4 m^2/g) and higher activity in sintering. It was possible to obtain briquettes with a 94% relative density after sintering at 1400°C during an hour in hydrogen. (auth)

27816 STRUCTURE AND PROPERTIES OF SINTERED POROUS CADMIUM–NICKEL MATERIALS. II. Terent'ev, N. K.; Pozin, Yu. M. Porosh. Met., Akad, Nauk Ukr. SSR; No. 8, 45-47(Aug 1973). (In Russian).

Data on microhardness, specific impact strength, and porosity are presented for samples obtained by the pressing and sintering of nickel and cadmium powder mixtures of different composition. The volumetric effect and porosity is studied as functions of sintering duration. Microphotographic sections are presented for samples of different phase composition. Conclusions are made on the suitability of the $Ni_{15}Cd_{12}$ alloy samples for manufacturing sintered electrodes of alkaline accumulators. (auth)

27817 ELECTROWINNING OF YTTRIUM–ALUMINUM AND YTTRIUM–MAGNESIUM ALLOYS FROM MOLTEN FLUORIDES. Bratland, D.; Boe, G.; Grjotheim, K. (Univ., Trondheim, Norway). Rev. Chim. Miner.; 10: No. 1, 347-353(1973).

Aluminum–yttrium and magnesium–yttrium alloys can be produced by the electrolysis of molten mixtures of LiF and YF_3 containing Y_2O_3, the cathode consisting of liquid aluminum or magnesium, respectively, floating on the electrolyte. The bath is agitated during the electrolytic process. The maximum yttrium concentrations obtained are 28% by weight for Al–Y alloys and 49% by weight for Mg–Y alloys. The metallothermic reduction of yttrium in the bath by the cathode metal is discussed. (FR)

27818 COATING MOLYBDENUM WITH PURE GOLD. Buttle, R. L. (to United States Atomic Energy Commission). U. S. Patent 3,741,735. 26 Jun 1973. Filed date 8 Jan 1964. 6p.

The invention is directed to a method of bonding gold to a molybdenum substrate by means of an intermediate layer of molybdenum oxide. The intermediate layer is formed during the plating of the gold and may be subsequently reduced to pure molybdenum to form a direct bond. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 27717, 28598, 29225, 29465, 29488, 29493, and 29538.

27819 (AD-760022) ANALYSIS OF THERMALLY-ACTIVATED FLOW IN IRON, MOLYBDENUM, AND NIOBIUM. Armstrong, R. W.; Campbell, J. D. (Maryland Univ., College Park. Engineering Materials Group). Apr 1973. Contract N00014-67-A-0239-0011. 11p. (EMG-124). NTIS.

The temperature and shear-strain-rate dependences of the flow stresses measured for single crystals or polycrystals of alpha-iron, molybdenum, and niobium are compared on the basis of the thermal activation–strain rate analysis (TASRA). Of particular concern is the TASRA parameter, the "activation volume", which is shown to follow a reciprocal dependence on the thermal component of shear stress, with fair accuracy. (auth)

27820 (AD-761814) COMPUTER ANALYSIS OF ALLOY SYSTEMS. Final Technical Report, May 1971–January 1973. Kaufman, L.; Nesor, H. (Manlabs, Inc., Cambridge, Mass.). Mar 1973. Contract F33615-71-C-1471. 145p. (AFML-TR-73-56). NTIS.

Computer analysis of 23 binary and 13 ternary titanium- and niobium-base systems was performed in order to provide phase stability and thermochemical characterization data which can be used to define fabrication procedures for achieving high-temperature stability and improved mechanical properties. M_s temperatures were calculated for titanium-base alloys with simultaneous additions of Mo, V, Al, Mn, and Sn. The effect of zirconium on the solubility of Si and Be in hcp titanium was calculated along with the occurrence of miscibility gap formation in bcc titanium-base systems. Titanium- and niobium-base ternary systems were analyzed to predict the temperature–composition trajectories of eutectoid and eutectic troughs and the location of melting-point minima. A method was developed for calculation of the eutectic temperature and composition of metal alloy–metal carbide systems and applied to the (Fe,Ni,Cr)-TiC case. (auth)

27821 (AD-762304) RESEARCH AND DEVELOPMENT OF RARE EARTH-TRANSITION METAL ALLOYS AS PERMANENT-MAGNET MATERIALS. Semiannual Interim Technical Report, 1 July–31 December 1972. Ray, A. E.; Strnat, K. J. (Dayton Univ., Ohio. Research Inst). May 1973. Contract F33615-70-C-1625. 44p. (UDRI-TR-73-19; AFML-TR-73-112). NTIS.

The results of room-temperature saturation magnetization and anistropy measurements made using an oscillating specimen magnetometer are reported for single crystals of the compositions $Pr_2(Co_{1-x}Fe_x)_{17}$, x = 0.2, 0.3, 0.4 and $Y_2(Co_{1-x}Fe_x)_{17}$, x = 0.1, 0.2 0.3. Measured values support earlier measurements made on packed powders of the same compositions. Values for the anisotropy constants, K1 and K2, are also given. The cerium–cobalt alloy system was re-examined, and a revised phase diagram is proposed. The thermal stability of the RCo_5 phase was investigated in $CeCo_5$, $PrCo_5$, and $NdCo_5$ using metallography, scanning electron microscopy, electron probe microanalysis, differential thermal analysis, and thermomagnetic analysis. (auth)

27822 (BNL-18110) NEUTRON STUDY OF THE BETA-TO-OMEGA INSTABILITY IN $Zr_{0.80}Nb_{0.20}$. Moss, S. C.; Keating, D. T.; Axe, J. D. (Brookhaven National Lab., Upton, N.Y.). 1973. 15p. (CONF-730561-1). Dep. NTIS $3.00.

From meeting on applications of phase transitions in materials science; University Park, Pennsylvania, USA (23 May 1973).

Neutron scattering from a single crystal of Zr-20% Nb, quenched from the bcc field, reveals both bcc Bragg peaks and intense diffuse scattering in the vicinity of the reciprocal lattice (rel) points of the trigonal omega (ω) phase. Neutron measurements revealed the ω diffuse scattering to have a strong elastic component. Phonon linewidths are wavevector dependent and, away from the zone center, are too broad to be observed. The results are discussed in terms of the dynamics of the phase transition and are qualitatively related to the lattice dynamics of the transition metals. (7 figures, 21 references) (auth)

27823 (FEI-321) RHENIUM EFFECT NATURE. Budagovskii, S. S.; Bykov, V. N.; Gavrilyuk, M. I. (Gosudarstvennyi Komitet Po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 36p. (In Russian). INIS.

A series of experimental investigations concerning the electronic structure, fine structure, stability, and ductility of solid solutions in the bcc W–Re lattice was generalized. The electron and fine structures of these solid solutions possessed a number of characteristics which were probably basic factors causing an anomalous effect on the stability and ductility of transition metals of Group VI. (tr-auth)

27824 (JPRS-59873, pp 71-74) EFFECT OF ALLOYING ELEMENTS ON SHIFT OF THE ALPHA-BETA TRANSFORMATION IN TITANIUM AND ZIRCONIUM. Braun, S. M. 1972. Translated from pp 141-144 of Tekhnologiya Poluchen'ya Novykh Materialov.

Effects of Cu (0.3 and 1.5 at. %) and Nb (0.2 and 5 at. %) on the $\alpha-\beta$ transformation temperature of Ti and Zr were studied from the viewpoint of the model of configuration localization of valency electrons. Both Cu and Nb lower the transformation temperature, but the Cu effect is greater in Zr than in Ti, while the Nb effect is greater in Ti. Results are explained in terms of d^2 structure. 14 references. (DLC)

27825 (JPRS-59873, pp 75-83) SOME PROPERTIES OF ZIRCONIUM WITH ADDITIONS OF TRANSITION METALS. Filippov, V. F. 1972. Translated from pp 144-153 of Tekhnologiya Poluchen'ya Novykh Materialov.

Effects of additions (0.5 and 1.0 at. %) of 18 d-transition metals on the microstructure, macrostructure, microhardness, and electric resistance of cast Zr were studied from the viewpoint of electronic structure. All the transition metals had a positive effect on the grain refinement, with the effect being greatest for group VIII metals. Plots of the other properties for the 4th, 5th, and 6th period metals show maxima at Mn, Mo, and Re. The metals that interact with Zr to form close-order groups with greatest localization of valency electrons and least number of unlocalized electrons, produce the greatest effect on nucleation and grain refinement. (DLC)

27826 (ORO-3262-31) DEFORMATION PROCESSES IN REFRACTORY METALS. Progress Report, December 1, 1972-November 30, 1973. Garde, A. M.; Donoso, J. R.; Reed Hill, R. E. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). 1973. Contract AT(40-1)-3262. 24p. Dep. NTIS $3.25.

Current work is largely concerned with the mechanical behavior of niobium, as affected by dynamic strain aging. In addition, the relation between the dislocation structure and the anomalous work-hardening phenomena associated with dynamic strain aging is being investigated with the aid of transmission electron microscopy. For this investigation titanium is currently being used. This will be replaced by niobium in the near future. (auth)

27827 CORRELATION BETWEEN THE CHARACTERISTIC TEMPERATURE AND THERMODYNAMIC FUNCTIONS OF METALS AND CERTAIN COMPOUNDS AT STANDARD TEMPERATURE. Ivanova, L. I. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 2, 250-252(Feb 1973).

Translated from Zh. Fiz. Zhim.; 47: No. 2, 445-446(Feb 1973).

The relation between θ_Φ and $S^*_{298.15}$ and also between θ_Φ and $\Phi^*_{298.15}$ for metals (including Y, Mo, Nb, Zr, Hf, W, Ta, Cd, and Be) and certain compounds was investigated. The possibility of estimating θ_Φ for various substances from the values of the thermodynamic functions at standard temperature was demonstrated. (auth)

27828 SPECIAL METALS: MATERIALS OF MODERN TECHNOLOGY. Booss, H. J. Metall; 27: No. 7, 716-724(1973). (In German).

Based on 220 references, a survey is given on the existing and future development of special metals, and the problems of application and process techniques for further development are shown. (GE)

27829 MECHANICAL PROPERTIES OF Ni-Mn MARAGING STEELS. Mukherjee, J. K. NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India); 13: No. 3, 65-68(1971).

The mechanical behavior of Fe-18Ni maraging alloys was studied by partial substitution of Ni by Mn. Age-hardened Fe-12Ni-5Mn-8Co-4Mo/Ti alloys showed tensile strength of the order of 100 tons/in.^{2} with satisfactory ductility and impact properties. Higher-manganese and lower-nickel alloys showed lower tensile strength with better ductility and impact values, although response to age hardening became less. Titanium caused embrittlement in these alloys in presence of Mn. (Indian Sci. Abstr.)

For abstracts of individual papers see: 27831-27834.

27830 MECHANICAL BEHAVIOR OF MATERIALS. Volume III. Temperature Effects of Metals; Environmental Effects; Polymers. Proceedings of the International Conference, Kyoto, Japan, August 15-20, 1971. Kyoto; Society of Materials Science (1972). 683p. (CONF-710851-P3).

25 papers cover aspects of temperature effects of metals: high-temperature mechanics, life estimation of creep and stress relaxation, microstructural studies of creep-rupture, new steels, etc. 13 papers cover environmental effects on fracture and fatigue, stress-corrosion cracking, corrosion, fretting fatigue, and wear of steels. Finally, 28 papers cover the mechanical and rheological behavior of high polymers. Separate abstracts have been prepared for four papers; one of the remaining was previously abstracted as NSA 27:22929. (DLC)

27831 IMPROVEMENT OF HIGH-TEMPERATURE STRENGTH OF 18-10 Mo (AISI 316H) AUSTENITIC STEEL. Shinoda, T. (Tokyo Inst. of Tech.); Tanaka, R.; Matsuo, T.; Mimino, T.; Kinoshita, K. pp 181-190 of Mechanical Behavior of Materials. Vol. III. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P3.

Type 316H austenitic steel shows an abnormal decrease in creep-rupture strength during prolonged periods of testing at 700°C. The cause of this phenomenon is approached from the viewpoint that rapid coalescence of precipitated carbide brings about a decrease in strengthening effect of the carbide dispersion. The combined addition of small amounts of Ti, Nb, and B is effective in making the carbide dispersion finer, resulting in preventing an abnormal decrease of the strength. With further addition of N, a new steel could be developed which has a 700°C-10^3hr rupture strength of 18.5 kg/mm^2. (8 figures, 15 references) (auth)

27832 DEVELOPMENT OF AUSTENITIC HEAT-RESISTANT STEEL CONTAINING A HIGH CONCENTRATION OF NITROGEN. Tanaka, R.; Shinoda, T.; Tobe, Y. (Tokyo Inst. of Tech.). pp 191-199 of Mechanical Behavior of Materials. Vol. III. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P3.

In order to develop high strength austenitic heat-resistant steels, a large amount of nitrogen together with C, Mo, W, V, and B were added to a 25% Cr-28%Ni steel. Creep rupture testing was carried out for up to 20,000 h on a few dozen specimens of the steels with various compositions. Three steels containing N, Mo, and W with or without B were seen to possess a good combination of properties. They are recommended as new super heat-resistant steels. Nitrogen coexisting with Mo and W in the steel was found to be a very useful alloying element. (auth)

27833 EFFECTS OF SMALL AMOUNTS OF CARBIDE-FORMING ELEMENTS ON THE ELEVATED-TEMPERATURE STRENGTH OF AUSTENITIC STAINLESS STEEL. Mimino, T. (Nippon Kokan K. K., Kawasaki, Japan); Kinoshita, K.; Minegishi, I.; Shinoda, T. pp 200-210 of Mechanical Behavior of Materials. Vol. III. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P3.

Effects of Ti, Nb, and/or Zr on elevated-temperature strength of 18%Cr-10%Ni austenitic steel were investigated. The amount of additions varied from very low values to atomic ratios to carbon of about 2 to 3. Creep rupture strengths for 10^3 and 10^4 h at 650 and 700°C, respectively, were analyzed and are discussed. The most interesting thing pointed out is that Nb and Zr have very large effects on elevated-temperature strengths especially at their low contents, i.e., atomic ratios to carbon being about 0.1 to 0.5, and it is also noted that Nb content for Type 347 is not an optimum value as to the elevated-temperature strength. The strengthening mechanism is also discussed. (4 figures) (auth)

27834 FATIGUE OF LOW-ALLOY STEELS IN AQUEOUS ENVIRONMENT AT ELEVATED TEMPERATURES. Kondo, T.; Kikuyama, T.; Nakajima, H.; Shindo, M. (Japan Atomic Energy Research Inst., Ibaraki). pp 319-327 of Mechanical Behavior of Materials. Vol. III. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P3.

Effect of high-temperature, pressurized water environment on the low-cycle fatigue behavior of low-alloy steels is studied with particular emphasis on the observed phenomenon of frequent incubation of crack propagation under low-frequency strain cycles. The incubation is found to occur only under particular combinations of the mode of cyclic loading and strain wave patterns in the environment of a simulated nuclear reactor (without irradiation). The results confirm a hypothesis that macroscopic corrosion pits tend to be formed at the tips of growing fatigue cracks and interrupt the growth of cracks. The conditions favorable to such a phenomenon are explored and a possible mechanism is discussed. Data are reported for A302B and A533B. (10 figures) (auth)

For abstracts of individual papers see: 27836 and 27837.

27835 MECHANICAL BEHAVIOR OF MATERIALS. Volume II. Fatigue of Metals. Proceedings of the International Conference, Kyoto, Japan, August 15-20, 1971. Kyoto; Society of Materials Science (1972). 562p. (CONF-710851-P2).

54 papers cover aspects of fatigue of metals and alloys such

as microstructure, crack propagation, effect of residual stress or prestrain, fractography, stress intensity factor, notch sensitivity, random fatigue, fatigue damage, life estimation, low cycle fatigue, high-temperature fatigue, etc. Separate abstracts have been prepared for two of the papers. (DLC)

27836 EFFECT OF MICROSTRUCTURE ON FATIGUE-CRACK PROPAGATION IN Ti-6Al-6V-2Sn ALLOY. Amateau, M. F.; Hanna, W. D.; Kendall, E. G. (Aerospace Corp., El Segundo, CA). pp 77-89 of Mechanical Behavior of Materials. Vol. II. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P2.

The fatigue crack growth behavior of Ti-6Al-6V-2Sn was investigated for five different microstructures, using contoured double-cantilever beam specimens. The fatigue crack growth behavior was compared with the mechanical strength, toughness, and ductility properties for each microstructure. The fatigue fracture surfaces were examined with a scanning electron microscope. Annealed structures consisting of equiaxed primary alpha have the lowest crack growth resistance, while the acicular alpha microstructure resulting from beta annealing has a growth resistance four times greater in the intermediate growth regime. No simple model of crack growth rate using gross mechanical properties describes the relative magnitude nor the relative order of crack resistance among the different microstructures. (auth)

27837 EFFECT OF PLASTIC ANISOTROPY IN LOW-CYCLE FATIGUE BEHAVIOR OF ZIRCALOY. Lee, D. (General Electric Research and Development Center, Schenectady, NY). pp 165-174 of Mechanical Behavior of Materials. Vol. II. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P2.

The mode of fracture and the changes in the plastic properties were examined with two differently textured Zircaloy-2 specimens under push-pull cyclic loading conditions. The swaged-rod had a planar isotropy and the cross-rolled plate had the clustering of basal plane poles, both in the plane normal to the loading axis. It was shown that both cyclic hardening and softening occurred with increasing number of cycles, depending largely on the strain range and the texture of materials. Depending on the particular orientation of specimen surface, the process of crack initiation could be closely identified with the slip morphology. The crack propagation, however, occurred in the direction normal to the surface where the corresponding plastic strain range was the largest. A mechanism of fatigue crack growth is suggested which is based on the cycle dependent activation of twinning ahead of the running crack. (7 figures, 25 references) (auth)

For abstracts of individual papers see: 27738, 27839-27841, 27887, and 27888.

27838 MECHANICAL BEHAVIOR OF MATERIALS. Volume I. Deformation and Fracture of Metals. Proceedings of the International Conference, Kyoto, Japan, August 15-20, 1971. Kyoto; Society of Materials Science (1972). 592p. (CONF-710851-P1).

22 papers are included on various aspects of plastic deformation of metals, such as microstructural studies, effects of irradiation, strain aging, etc. 30 papers discuss the fracture of metals in terms of theory, fracture mechanics, crack initiation and propagation, ductile and brittle fracture, etc. Separate abstracts have been prepared for 6 of the papers. (DLC)

27839 STRENGTHENING AND FRACTURE OF Ta, Nb, Mo, AND W BINARY SOLID SOLUTIONS WITH SHORT-RANGE ORDER. Predmore, R. E. (Univ. of Maryland, College Park); Arsenault, R. J.; Sparks, C. J. Jr. pp 18-30 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

The binary substitutional solid solution alloys of Nb, Mo, Ta, and W exhibit two types of behavior. Ta-Nb and probably Mo-W alloys form random solid solutions with an absence of substitutional solid solution hardening and an absence of fracture embrittlement at high solute concentrations. Ta-Mo, and probably Ta-W, Nb-Mo, and Nb-W alloys form short-range ordered solid solutions. They have linear solid-solution hardening to high solute concentrations at room temperature, and fracture embrittlement at high solute concentration. Diffuse x-ray scattering shows the solution hardening of Ta-Mo alloys is caused primarily by size misfit and displacement of the solute atom off the average lattice site, and secondarily by shear modulus misfit. (6 figures, 2 tables, 18 references) (auth)

27840 MECHANICAL BEHAVIOR OF HIGH-STRENGTH BETA-TITANIUM ALLOYS. Ono, K. (Univ. of California, Los Angeles); Rosales, L. A.; Motokura, S.; Sommer, A. W. pp 66-77 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

Thermomechanical treatments of Beta-III (11.5 Mo-6 Zr-4.5 Sn-Ti) and 18 Mo-Ti were performed in order to study microstructure-mechanical property relationships. Transmission electron microscopy was employed to delineate the effects that prior cold work and multiple aging steps produce in microstructure. The optimum combination of strength (230 ksi) and good ductility/toughness is obtained by cold work of the β-phase followed by preaging in the $\omega + \beta$ region and final aging in the $\alpha + \beta$ region to produce an extremely fine distribution of α-particles in the β-matrix. Results of an internal friction study on a series of β-Ti alloys containing various amounts of Mo and V with and without plastic deformation are also presented in order to describe the fundamental nature of the $\beta \rightarrow \omega$ transformation. These results indicate the transformation to be of the "atom shuffle" or displacive type. (auth)

27841 RELATIONS BETWEEN SUPERPLASTICITY AND HIGH-TEMPERATURE RESISTANCE ALLOYS OF METALLIC SYSTEMS. Kornilov, I. I. (Inst. of Metallurgy, Moscow). pp 78-86 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

Study of heat resistance of the metallic alloys on the basis of aluminum, iron, nickel, and titanium showed a correlation between the maximum values of heat resistance and superplasticity in the systems investigated. These relations are most evident from the "composition-heat resistance" diagrams. A complex feature of the correlation between two antipodal properties — heat resistance and superplasticity — in metallic systems is not accidental and can be explained by differences in the structure, phase nature, and phase reactions in the solid state which take place in the processes of decomposition of supersaturated solid solutions. It is shown that the heat resistance and superplasticity of the alloys of the same system should be discussed in accordance with the type of phase diagram and the effects of composition, structure, dispersity, and phase interaction in the metallic systems. A comparison of maximum values of heat resistance and superplasticity of the alloys with the phase diagram of the metallic systems is of interest in the development of a physico-chemical theory of heat resistance of the metallic alloys. (17 references) (auth)

27842 INTERNAL FRICTION IN FIBER-REINFORCED COPPER COMPOSITES (TUNGSTEN WIRE). Yamane, T.; Umakoshi, Y.; Tomishima, M.; Nakai, K. (Osaka Univ., Suita, Japan). pp 220-230 of Mechanical Behavior of Materials Vol. V. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P5.

Internal friction of tungsten fiber-reinforced copper composites was obtained by a free natural decay of transversal resonance vibration. The strain-amplitude-independent internal friction of fully annealed composites first decreased by cold rolling then increased at a higher rolling degree. This was considered to be due to effects of thermal strain produced by the difference of thermal expansion coefficients between the copper matrix and the tungsten fibers. The strain-amplitude-independent internal friction of the composites annealed after cold rolling decreased for the recovery of the copper matrix, and increased by annealing over 200°C for the effects of the thermal strain. (12 figures, 20 references) (auth)

27843 ELECTRICAL RESISTIVITY AND THERMAL CONDUCTIVITY OF ALLOYS OF THE TUNGSTEN-MOLYBDENUM SYSTEM. Vertogradskii, V. A.; Chekhovskoi, V. Y. (Inst. of High Temperature, Moscow). High Temp.-High Pressures; 4: No. 6, 621-626(1972).

Measurements are reported of the transport coefficients of Mo-86.5%W (from 1200 to 3000°K) and Mo-34.4%W alloys from 1200 to 2800°K. Results are also given for pure W (up to 3000°K) and Mo (up to 2600°K). The electrical resistivity was measured on wire specimens using a potentiometric technique in conjunction with a tubular furnace with a side hole for sighting a pyrometer. Thermal conductivity was measured under the conditions of exponential temperature distribution in a wire specimen heated by electric current. The exponential factor was measured with the aid of a differential plot by using the ratio between voltage drops along two portions of the sample. The error in the electrical resistivity data is ~ 1% and in the thermal conductivity data < 5%. The results are used to derive the composition dependence of the electrical resistivity and of the Lorenz number. (auth)

27844 TEXTURE IN URANIUM-0.7 WT. % TITANIUM ALLOY. Werkema, M. S. (Dow Chemical Co., Golden, CO). J. Nucl.

Mater.; 48: No. 2, 125-130(Sep 1973).

The effects of extrusion, shear spinning, and heat treatment on preferred orientation were investigated for uranium–0.7 wt. % titanium. A ⟨410⟩, ⟨010⟩ fiber texture was observed in the extrusion. An ⟨001⟩ radial texture is developed during shear spinning. (auth)

27845 FACE-CENTERED-CUBIC ERBIUM AND THE SPACE GROUP OF ERBIUM OXIDE Er_2O_3. Curzon, A. E.; Chlebek, H. G. (Simon Fraser Univ., Burnaby, British Columbia). J. Less-Common Metals; 32: No. 3, 365-369(Sep 1973).

The electric conductivity at 20°C of an fcc phase observed when thin films of erbium are formed by vapor deposition is $\sim 0.2 \times 10^4$ ohm-cm $^{-1}$. The resistance of a given film increases by 0 to 10% when the film is cooled to 77°K. These results and other experimental data previously published are used to support the view that the phase in question is not a p-type semiconducting oxide, ErO, but a new, thin-film form of metallic erbium. It is pointed out that an unambiguous determination of the space group of Er_2O_3 cannot be made by means of electron-diffraction methods unless care is taken to ensure that double diffraction does not occur in the specimens. (auth)

27846 ANOMALOUSLY LARGE THERMOELECTRIC COOLING FIGURE OF MERIT IN THE KONDO SYSTEMS $CePd_3$ AND $CeIn_3$. Gambino, R. J.; Grobman, W. D.; Toxen, A. M. (IBM Watson Research Center, Yorktown Heights, NY). Appl. Phys. Lett.; 22: No. 10, 506-507(15 May 1973).

Measurements of thermopower, resistivity, and thermal conductivity for the rare-earth intermetallic compounds $CePd_3$ and $CeIn_3$ indicate an anomalously large Peltier-effect cooling figure of merit at low temperatures associated with a large thermopower. Resistivity and susceptibility measurements indicate that these compounds possess localized Ce 4f electrons that give rise to the Kondo effect and thermopower enhancement. These results suggest that a survey of Ce intermetallic compounds could lead to new materials for low-temperature thermoelectric cooling applications. (auth)

27847 ELECTRICAL RESISTIVITY OF α-CERIUM. Brodsky, M. B.; Friddle, R. J. (Argonne National Lab., IL). Phys. Rev., B; 7: No. 7, 3255-3260(1 Apr 1973).

Electrical-resistivity measurements were made between 1.5 and 300°K on α-cerium cooled while at pressures of 10 or 18 kbar. Two types of behavior were found: Cerium quenched from 300 to 77°K showed the presence of a magnetic impurity, possibly clusters of β-cerium, and cerium which was slowly cooled from room temperature showed no evidence of magnetic behavior. Whereas the "magnetically impure" sample showed a strong $\rho \propto T^2$ dependence at low temperatures, the slowly cooled sample had $\rho \propto T^5$. It is suggested that the magnetic impurity present in previous studies may have prevented the observation of superconductivity in α-cerium. (4 figures, 23 references) (auth)

27848 FATIGUE HARDENING IN NIOBIUM SINGLE CRYSTALS. Doner, M.; Diprimio, J. C.; Salkovitz, E. I. (Univ. of Pittsburgh). Acta Met.; 21: No. 11, 1547-1559(Nov 1973).

Niobium single crystals of various orientations were cyclically deformed in tension–compression under strain control. At low strain amplitudes all crystals oriented for single slip and some oriented for multiple slip showed a two-stage hardening. When present, the first stage was characterized with almost no cyclic work hardening. The rate of hardening in the second stage increased with strain amplitude and the amount of secondary slip: however, in all cases it was considerably less than θ_{II} in unidirectional deformation. In crystals oriented for single slip kink bands developed on their side faces during rapid hardening stage which resulted in considerable amount of asterism in Laue spots. A cyclic stress–strain curve independent of prior history was found to exist that was also independent of crystal orientation. Furthermore, this curve differed only slightly from that of polycrystalline Nb obtained from data in literature. (auth)

27849 CERTAIN DETAILS OF THE ELECTRON STRUCTURE OF W–Re SOLID SOLUTIONS. Budagovskii, S. S.; Bykov, V. N.; Gavrilyuk, M. I.; Pod'yachev, V. N. (All-Union Scientific-Research Inst. of Aviation Materials, Moscow). Metallofizika; No. 44, 57-67(1973). (In Russian).

Results are presented of measurements of the electrical resistance, Hall effect, magnetic resistance, crystal lattic parameter, angular correlation of annihilation photons, and magnetic susceptibility of alloys in the tungsten–rhenium system in the region of solid solutions with a bcc lattice. The concentration dependencies of these properties show anomalies, whose positions concentrationwise coincide for all properties. On analyzing the experimental data, it is concluded that these anomalies are due to the nonmonotonic effect that alloying with rhenium has on the character of the distribution of valence electrons around the nodes of the crystal lattice. (tr-auth)

27850 DETERMINATION OF CRYSTALLOGRAPHIC RELATIONSHIPS IN THE FIBROUS EUTECTIC Ni(Cr)–TaC. Henry, M. F.; Koch, E. F. (General Electric Co., Schenectady, NY). Prakt. Metallog.; 10: No. 8, 439-449(1973). (In German and English).

An alloy of Ni–10Cr–14.9 Ta–1.1C was directionally solidified through a pseudobinary eutectic reaction to yield a Ni(Cr) matrix with highly aligned TaC fibers. A transverse section was thinned by ion milling and the crystallographic relationship between the two phases was determined by the use of selected-area transmission electron diffraction. Fibers and matrix have ⟨100⟩ growth direction. The TaC fibers are predominantly square in cross section with (110) faces. The matrix orientation in plane is coincident with that of the fibers and the two phases thus have a common interface plane, (110). This plane gives a 21% lattice mismatch. (GE)

27851 EXCITATION OF 4d ELECTRONS IN RARE-EARTH METALS BY INELASTIC SCATTERING OF A HIGH-ENERGY ELECTRON BEAM. Trebbia, P.; Colliex, C. (Paris Univ., Orsay, France). Phys. Status Solidi (b); 58: No. 2, 523-532 (1 Aug 1973).

4d electron excitations were investigated in several rare-earth metals (Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb) by means of electron energy losses of a high energy (75 keV) electron beam. Experiments were made with a transmission electron microscope modified by the adjunction of a Castaing–Henry dispersive system. Results of the measurements lying in the energy range between 120 and 190 eV agree rather well with x-ray photoabsorption spectra and oscillator strengths calculated in an atomic model. (auth)

27852 NUCLEAR MAGNETIC RESONANCE OF ^{181}Ta IN Ta_3Sn. Wada, S. (Kobe Univ., Japan); Asayama, K. J. Phys. Soc. Jap.; 34: No. 5, 1163-1167(May 1973).

The NMR signal of ^{181}Ta in the intermetallic compound of Ta_3Sn was observed at 4.2°K. The effective gyromagnetic ratio of the signal is deduced to be 13.0 MHz/10 kOe. It is shown that the signal observed corresponds to the transition between the Zeeman levels which are associated with the $|\pm \frac{1}{2}>$ states of the pure quadrupole spectra and separated by an external magnetic field. The NMR signal of Re nuclei in pure Re metal was also observed, which was caused by the same mechanism for that of ^{181}Ta in Ta_3Sn. (auth)

27853 NUMBER OF REGULARITIES IN TEMPERATURE DEPENDENCE OF MICRODEFORMATION OF bcc ALLOYS OF Fe–Cu–Ti, W, AND W–Re. Sheremet'ev, O. D.; Pochivalov, Yu. I.; Korotaev, A. D.; Amosov, V. M. (Physical-Technical Inst., Novosibirsk, USSR). Metallofizika; No. 44, 16-21(1973). (In Russian).

This study deals with the temperature dependence (in the interval from 77 to 673°K) of the resistance to microdeformation $\sigma_0(\epsilon \sim 5 \times 10^{-6})$, of deformation strengthening regularities in the region of microflow ($\epsilon = 5 \times 10^{-6}$ to 1×10^{-3}), and of the macroscopic yield point for tungsten and the alloys Fe + 2% Cu + 0.15% Ti, W + 5%, Re, W + 20% Re, and W = 27% Re. It is shown that within the temperature interval under study, the resistance to microdeformation σ_0 varies insignificantly with a decrease in temperature, so that the temperature dependence of the macroscopic yield point is determined by a change in strengthening in the region of microdeformation. Decomposition of the Fe–Cu–Ti alloy with separation of a coherent phase leads to a change in characteristics of microdeformation which is analogous to a decrease in temperature. The details which were observed are related to a difference in mobility for screw and edge dislocations. (tr-auth)

27854 EFFECT OF TEMPERATURE AND RATE OF DEFORMATION ON TYPE OF ELONGATION AND ON PLASTIC PROPERTIES OF MOLYBDENUM. Pavlov, V. A.; Pereturina, I. A. (Inst. of the Physics of Metals, Moscow). Metallofizika; No. 44, 3-5(1973). (In Russian).

The study deals with the type of elongation and plastic properties of three heats of Mo (which differ from each other in the content of intrusive impurities) at 200 to 1000°K and three rates of elongation: 7×10^{-3}, 7×10^{-4}, and 7×10^{-5} sec^{-1}. The purest molybdenum showed three stages of strengthening with the presence and magnitude of deformation at the stage of slight slip strongly dependent on the temperature and rate of deformation. All heats of Mo are characterized by the presence of plasticity maxima on plotting relative elongation as a function of temperature. The phenomena are tentatively explained by the interaction of moving dislocations with the intrusive impurity atoms. (tr-auth)

27855 NEW X-RAY EMISSION BANDS OF Sn, Sc, Re, AND Os IN THE WAVELENGTH RANGE 90 TO 900 A. Shulakov, A. S.; Fomichev, V. A.; Zimkina, T. M. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 10, 2644-2645

(Apr 1973).

Translated from Fiz. Tverd. Tela; 14: No. 10, 3088-3089 (Oct 1972).

The bands are plotted over the range of 15 to 60 eV, and the positions of the maxima are tabulated together with experimental conditions. The bands of Re and Os were identified using the Moseley diagram; the A and A_1 maxima correspond to the maximum of the $O_{III}(5p_{\frac{1}{2}})$ and $O_{II}(5p_{\frac{3}{2}})$ bands of these elements. The a and b maxima of Os correspond to the $N_{VII}(4f_{\frac{5}{2}})$ and $N_{VI}(4f_{\frac{7}{2}})$ bands. The O_{III} and N_{VII} bands are superimposed in the Re band. For Sn, the A and A_1 maxima correspond to the $N_V(4d_{\frac{5}{2}})$ and $N_{IV}(4d_{\frac{3}{2}})$ bands. The B maxima of Sn and Os represent the fine structure of the N_V and O_{III} bands. (DLC)

27856 NATURE OF INTERATOMIC BOND CHANGE IN THE INTERCRYSTALLITE ZONES OF LOW-ALLOYED Mo AS A FUNCTION OF THE ANNEALING TEMPERATURE. Arkharov, V. I.; Drachinskii, A. S.; Pisarenko, V. A.; Samoilenko, Z. A.; Trefilov, V. I. (Physical-Technical Inst., Donetsk, USSR). Dokl. Akad. Nauk SSSR; 210: No. 5, 1060-1062(11 Jan 1973). (In Russian).

In order to investigate differences in carbide formation within a Mo-alloy containing 0.5% Ti, 0.05% Zr and 0.012% C, shifts in the emission lines of the x ray spectrum were followed under various annealing conditions from 1400 to 2300°C. The samples were surface layers of intercrystallite fractures. The chemical composition of the intercrystallite zones was found to be different from the chemical composition in the body of the crystallite. After annealing at 1400 to 1600°C and rapid cooling, the intercrystallite fractures showed an increased content of Ti and the appearance of TiC particles. Annealing at 1700 to 1900°C led to the formation of zirconium carbide. Particles of Mo_2C were observed at higher temperature on surface fractures. No changes were observed in the body of the crystalline particles. The phenomena could be interpreted as a decomposition of a solid solution formed at the crystal face. Shifts in the x-ray emission lines of the various carbides are discussed. (tr-auth)

27857 SELF-CONSISTENT BAND STRUCTURE OF NIOBIUM AT NORMAL AND REDUCED LATTICE SPACINGS. Anderson, J. R. (Univ. of Maryland, College Park); Papaconstantopoulos, D. A.; McCaffrey, J. W.; Schirber, J. E. Phys. Rev., B; 7: No. 12, 5115-5121(15 Jun 1973).

Self-consistent augmented-plane-wave energy-band calculations were carried out for niobium for (a) normal lattice constant, $\alpha = 1$ exchange, (b) normal lattice constant, $\alpha = \frac{2}{3}$ exchange, and (c) 5% reduced lattice constant, $\alpha = \frac{2}{3}$ exchange. At normal lattice constant, $\alpha = \frac{2}{3}$ exchange, an occupied s-d-band width of 0.387 Ry is found, in very good agreement with both L and M soft-x-ray emission experiments. The calculated density of states at the Fermi energy is 28.2 states $atom^{-1}$ Ry^{-1}, corresponding to a McMillan enhancement factor of 1.6. The Fermi surface consists of hole ellipsoids centered at N, a large hole octahedron centered at Γ, and a multiply connected "jungle gym," similar to that calculated by Mattheiss. The largest difference between experimental and calculated areas is less than 15%. (7 figures, 3 tables, 25 references) (auth)

27858 BRITTLE FRACTURE STRENGTH OF WELDED JOINTS. Varga, T. Sulzer Tech. Rev.; 55: No. 1, 16-28(1973).

The need to evaluate components, particularly pressure vessels, for susceptibility to brittle fracture is discussed. Emphasis is on welded vessels of ferritic structural steels. The variables affecting fracture behavior are state of stress, temperature, and deformation rate; their effects are described and examples discussed. Suggestions are given on possible ways of reducing brittle fracture susceptibility. Often the usual notched-bar impact test no longer provides a satisfactory basis for assessing the brittle fracture safety of a structural member, notably in cases of heavy wall thickness and of high-tensile materials or welded joints. Hence possibilities and limitations of the most common brittle fracture tests are covered. (25 figures, 36 references) (auth)

27859 COARSENING OF THE Sn-Cd EUTECTIC AT ROOM TEMPERATURE. Gruzleski, J. E.; Dean, H. (McGill Univ., Montreal). J. Cryst. Growth; 19: No. 4, 338-340(Jul 1973).

Samples of unidirectionally solidified Sn-Cd eutectic were re-examined after being kept for periods of 6 or $2\frac{1}{2}$ years at room temperature. Extreme coarsening in faulted samples can occur at room temperature in these periods of time. Nonfaulted grains do not exhibit severe coarsening. The apparent lack of thermal stability of this eutectic is thought to be caused by a destruction of the low-energy interphase interface in a eutectoid transformation at 133°C. (auth)

27860 COMPOSITE MATERIAL WITH TITANIUM AS A BASE. Ageev, N. V.; Petrova, L. A.; Grankova, L. P.; Markov, A. M. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 4, 811-814(1 Jun 1973). (In Russian).

Hot rolling in vacuum was used to obtain a composite (layered) material with titanium as its base. The rolling temperature was 1150°C with ~30% reduction to a thickness of 0.6 mm. The heating time was ~10 sec. An alloy containing Ti-7 Mo-5.5 Cr-3 Fe-3 Al was used as the starting, high-strength material. Strength tests showed that samples consisting of n layers of the same material possess greater strength than the monolithic material. (tr-auth)

27861 LAVES DOUBLE AND TRIPLE PHASES IN ZIRCONIUM SYSTEMS WITH TRANSITION METALS OF V TO VII GROUPS. Ermenko, V. N.; Prima, S. B.; Tret'yachenko, L. A. (Kiev State Univ.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 139-142(1973). (In Russian).

Laves double phases were studied in the binary systems V-Zr, Cr-Zr, Mn-Zr, Nb-Zr, Mo-Zr, Ta-Zr, and W-Zr and triple phases were studied in the ternary systems Zr-Cr-V, Zr-Cr-Mo, and Zr-Cr-Mn. The Laves phase in the Mo and W alloys have only a cubic structure of the $MgCu_2$ type, in contrast to $ZrCr_2$ with two polymorphic modifications. The Zr-V is similar to the Zr-Mo and Zr-W systems. Phase diagrams of the $ZrCr_2$-ZrV_2, $ZrCr_2$-$ZrMo_2$, and $ZrCr_2$-$ZrMn_2$ were constructed. (JSR)

27862 INFLUENCE OF ALUMINUM ON Ti + 10% V ALLOY STRUCTURE AND PROPERTIES. Kolachev, B. A.; Lokshin, F. L.; Lyasotskaya, V. S.; Sovalova, E. G.; Korobov, O. S. (Moscow Aviation Tech. Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 149-152(1973). (In Russian).

The alloys Ti + 10% V, Ti + 10% V + 3% Al, and Ti + 10% V + 6% Al were melted by the double melting method and then annealed. In the Ti + 10% V alloy the following structures were detected: $\alpha + \beta$, $\alpha + \beta + \omega + \alpha$, $\alpha + \alpha$ and α. In the Ti + 10% V + 3% Al and Ti + 10% V + 6% Al the structures detected were $\alpha + \beta$, $\alpha + \beta + \alpha$, $\alpha + \alpha$, and α. Al expands the annealing temperature under tempering after tempering with which the α phase is fixed. Al inhibits the formation of the ω phase after tempering. Al decreases the quantity of the ω phase formed during aging of the tempered alloy. (tr-auth)

27863 FAZOVYE PREVRASHCHENIYA I IZMENENIYA SVOISTV SPLAVOV TITANA PRI SVARKE. (Phase Conversions and Changes of the Properties of Alloys of Titanium During Welding). Shorshorov, M. Kh.; Meshcheryakov, V. N. Moscow; Izdatel'stvo Nauka (1973). 158p.

The characteristics, conditions, and mechanisms of the delayed breakdown of welded compounds of titanium alloys were examined. The effects of gas impurities and alloying elements on the formation of cold cracks were studied. Data are reported for the calculated selection of the regime and technology of welding and subsequent heat treatment, making it possible to guarantee the optimum structure and properties of the zone of the welded compound. About two hundred reference graphs and diagrams are given. (92 references) (tr-auth)

27864 ABRASIVE ABILITY AND STRENGTH OF β-RHOMBOHEDRAL BORON GRAINS. Samsonov, G. V.; Adamovskii, A. A.; Bezykornov, A. I.; Uvarov, V. V.; Nemtsova, N. Ya.; Tsagareishvili, G. V.; Tsomaya, K. P. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 8, 58-62(Aug 1973). (In Russian).

The strength of β-boron surpasses that of electrolytically produced white corundum, elbor synthetic diamond of ACO trademark and is inferior to silicon green carbide and diamond of the ACB trademark. The abrasive ability is shown to be an integral function of the grain strength for crushing and microhardness. The abrasive ability of β-boron is 2.5 to 2.7 times as high as that of electrically produced white corundum and 1.3 to 1.5 times as high as that of silicon green carbide. (auth)

27865 PACKING DEFECTS IN Mo-Ta AND Mo-C ALLOYS. Noskova, N. I.; Pavlov, V. A. (Inst. of the Physics of Metals, Moscow). Metallofizika; No. 44, 53-57(1973). (In Russian).

Data are presented on x-ray determination of the probability of packing defects in powders of solid solutions of Mo-Ta and Mo-C. It is shown that the probability of packing defects during alloying increases in all cases. The packing defect energy is estimated for solid solutions of these alloys. (tr-auth)

27866 EFFECT OF PLASTIC DEFORMATION ON PARAMAGNETIC SUSCEPTIBILITY OF SINGLE-CRYSTAL MOLYBDENUM. Deryagin, A. L; Pavlov, V. A.; Vlasov, K. B.; Grubova, S. P. (Inst. of the Physics of Metals, Moscow). Metallofizika; No. 44, 6-10(1973). (In Russian).

With increasing degree of plastic deformation, a rise in the room-temperature susceptibility of Mo is observed along with the occurrence of a nonlinear dependence of the susceptibility

as a function of the magnetic field strength in the region up to 1000 Oe. (tr-auth)

27867 STUDY OF Mo–Ni–C, Mo–Ni–Zr, AND Mo–Zr–Ni–C ALLOYS ENRICHED IN MOLYBDENUM. Zakharov, A. M.; Kurganov, G. V.; Parshikov, V. G. Izv. Akad. Nauk SSSR, Metal.; No. 3, 224-228(1973). (In Russian).

By microstructural and x ray phase analyses and by measuring the initial melting temperature and microhardness of alloys quenched from temperatures of 1200 and 1800°C, phase diagrams were investigated from the molybdenum side. Isothermal sections of all the systems and polythermal sections of the Mo–Zr–Ni–C system were obtained at a constant content of 0.2% Ni (Zr : C = 7.6 : 1) and of 0.2% Ni + 0.09% C. At a temperature of 1800°C in the ternary alloys of Mo–Ni–C and Mo–Ni–Zr, besides a molybdenum α-solid solution, the carbide Mo_2C and the Mo–Ni compound there is a liquid phase present, and at 1200°C the compound Mo_2Zr occurs. In Mo–Zr–Ni–C quaternary alloys there are found only those excess phases which are encountered in Mo–C, Mo–Zr, and Mo–Zr–C alloys, that is, the carbides Mo_2C and ZrC and the compound Mo_2Zr. There are no quaternary compounds in these alloys. Small additions of nickel (0.2%) somewhat increase the mutual solubility of carbon and zirconium in solid-state molybdenum, by which it is possible to explain the positive effect of nickel on the plasticity of molybdenum and its low-content alloys containing zirconium. (tr-auth)

27868 STRENGTH AND PLASTICITY OF TANTALUM DURING SHORT-TERM TESTS. Severdenko, V. P.; Kal'nitskii, R. M. Izv. Akad. Nauk SSSR, Metal.; No. 3, 143-146(1973). (In Russian).

The strength and plasticity of previously deformed tantalum were determined. Deformation was carried out over a temperature interval of 20–1000°C and a range of deformation rates of 13 to 300 mm/min, and of initial deformation rates of 3×10^{-2} to 6×10^{-1} sec^{-1}. On increasing the temperature from 20 to 1000°C, the rupture strength decreased by a factor of 1.5 from 75–85 to 45–59 kg/mm^2. The decrease is not monotonic. Anomalous strength peaks were noted at deformation rates of 0.1 to 0.03 sec^{-1} and temperatures of 450 to 500°C. This phenomenon is ordinarily explained by deformation aging mainly as a result of the interaction of dislocations with intrusive oxygen atoms. The relative elongation at rupture, the true deformation, and plasticity of tantalum are given as a function of temperature up to 500°C and initial deformation rates of 6×10^{-1}, 3×10^{-1}, and 3×10^{-2} sec^{-1}. The relative elongation of tantalum at about 88% is constant with temperature from 20 to 500°C. (tr-auth)

27869 EFFECT OF COLD DEFORMATION AND THERMAL TREATMENT ON ELASTIC PROPERTIES OF NIOBIUM. Prokoshkin, D. A.; Vasil'eva, E. V.; Markova, S. A. Izv. Akad. Nauk SSSR, Metal.; No. 3, 147-150(1973). (In Russian).

Forged pieces of electron-beam melted niobium after a recrystallization annealing were subjected to cold rolling with a reduction greater than 50% into a sheet 0.2 mm thick. Vacuum arc-melted niobium was subjected to the same treatment with 90% reduction. The elastic modulus and tensile strength were measured on pieces $100 \times 5 \times 0.2$ mm in size taken from the rolled film in a direction transverse to the rolling. The electrical resistance and microhardness were measured. The dislocation density increased from 0.5×10^{10} cm^{-2} at 25% reduction to 4×40^{-11} cm^{-2} at 90% reduction. With increasing degree of deformation, there is a continuous increase in the width of the (200) and (310) lines. A sharp increase in microhardness is observed with 50% deformation and higher. The normal value of the elastic modulus of the electron-beam melted niobium varied from 8300 kg/mm^2 in the initial state to ~9300 kg/mm^2 after 90% deformation. The arc-melted niobium which contained more impurities showed an elastic modulus of 9800 kg/mm^2 after 90% reduction. The tensile strength ($\sigma_{0.002}$) of arc-melted niobium with optimal annealing at 900°C for 30 min showed an increase of 130% after 90% reduction as compared to its tensile strength in the initial state. The increase in tensile strength for the electron-beam niobium was lower at ~80%. (tr-auth)

27870 NUCLEAR MAGNETIC RESONANCE OF ^{51}V IN IRON-RICH Fe–V ALLOYS. Fujiwara, Y.; Nomura, M.; Fujiwara, H. (Hiroshima Univ.). J. Phys. Soc. Jap.; 34: No. 6, 1690(Jun 1973).

Spin echo spectra were observed at 4.2°K for 1.1, 2.5, 5, 7.5, and 10 at. % V. Two satellite lines were observed at 82 and 68 MHz for all the alloys, except 68 MHz in the 1.1 at. % V alloy. New lines at 87 and 95 MHz were also observed in the 1.1 at. % V alloy. The probable V atom configurations responsible for the lines are discussed. (DLC)

27871 EFFECT OF PRESSURE ON THE Pb–In ALLOY PHONON IMPURITY ZONE. Gaikin, A. A.; Svistunov, V. M.; Chernyak, O. I.; Belogolovskii, M. A. (Physical Technical Inst., Donetsk, USSR). Dokl. Akad. Nauk SSSR; 210: No. 4, 815-817(1 Jun 1973). (In Russian).

This study deals with the pressure displacement of details in the oscillatory spectrum of lead, which arise on introducing a slight indium impurity. The $Pb_{0.93}$ $In_{0.07}$ film was condensed on a backing at a high rate of evaporation (700 to 1000 Å/sec). Results were obtained at 1.2°K in the range of pressures up to 9 kbar. With decreasing volume the phonon spectrum of a metal is shifted to the side of higher energies. From known values of the compressibility $x = 2.37 \times 10^{-6}$ bar^{-1} and the Gruneisen constant $\gamma = 2.85$, the rate of change in the impurity peak under pressure is given by $x\gamma = 6.75 \times 10^{-6}$ bar^{-1}. The experimental value was found to be $x\gamma = 5.8 \pm 1 \times 10^{-6}$ bar^{-1}. (SJR)

27872 MODEL OF THE FERMI SURFACE FOR ANTIFERROMAGNETIC EUROPIUM METAL. Greene, M. P.; Kiwi, M. (Univ. of Maryland, College Park). Solid State Commun.; 13: No. 5, 541-542(1 Sep 1973).

Energy gaps near the Fermi surface arising from magnetic Brillouin-zone effects must be taken into account in order to understand the antiferromagnetism of europium metal. (auth)

27873 AMBIVALENCE OF Yb IN $YbAl_2$ AND $YbAl_3$. Havinga, E. E.; Buschow, K. H. J.; van Daal, H. J. Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands). Solid State Commun.; 13: No. 5, 621-627(1 Sep 1973).

Results are reported of a study of the intermetallic compounds $YbAl_2$ and $YbAl_3$ with regard to lattice constant, electronic specific heat, superconductivity, magnetic susceptibility, and resistivity. The experimental data suggest that the Yb ions in $YbAl_3$ are close to trivalent and yet, at low temperatures, without a magnetic moment. The low-temperature data of both compounds are interpreted, assuming a virtual bound 4f state just below the Fermi level. The number of holes in this state is high, and estimated to be about 0.9 for $YbAl_3$ and 0.5 for $YbAl_2$. The high-temperature data are discussed with a two-level model, the excited state being the normal magnetic trivalent state. (auth)

27874 ELECTRICAL RESISTIVITY OF QUENCH-CONDENSED CERIUM FILMS. Loeffler, E.; Mydosh, J. A. (Kernforschungsanlage, Juelich, Ger.). Solid State Commun.; 13: No. 5, 615-619(1 Sep 1973).

Quench-condensed (500 to 1500 Å) films of cerium were prepared at liquid helium temperature, and the electrical resistivity was measured from 1.5 to 300°K. A strongly disordered form of α-Ce was stabilized. An initial T^2 term was found in the resistivity. The overall behavior of the resistivity suggests the existence of nearly magnetic regions, due to the large inherent lattice disorder, and the applicability of localized spin fluctuation theory. (auth)

27875 MAGNETIC HYPERFINE FIELDS IN ACTINIDE MATERIALS. Dunlap, B. D.; Kalvius, G. M. (Argonne National Lab., IL). Int. J. Magn.; 24: No. 4, 231(Aug 1972).

Magnetic hyperfine fields in light actinide materials (mostly U, Np, Am) are discussed in terms of the special features appropriate to this series. In particular, the importance of relativistic effects is stressed. The free-ion hyperfine fields are calculated in terms of relativistic hyperfine interaction theory, using $\langle r^{-3} \rangle$ values obtained from relativistic self-consistent-field calculations. Experimental results, especially data obtained by Moessbauer spectroscopy, are reviewed with the aim of uncovering some basic systematic features. It is shown that unlike the case of the rare earths, important influences on the hyperfine fields are caused by the large-core polarization fields, the strong crystalline field interactions often present, and the pronounced tendency of delocalization of 5f electrons into bands in metallic systems. The relation between the hyperfine fields and the electronic magnetic moments is examined as a test for admixture of states with different total angular momentum. In conclusion, it is demonstrated that while the behavior of magnetic hyperfine fields in 5f transition elements is considerably more complex than in the analogous 4f series, the limited data available clearly show systematic trends. (auth)

27876 DETECTION OF MAGNETO-ACOUSTIC OSCILLATIONS IN NIOBIUM. Leibowitz, J. R. (Catholic Univ. of America, Washington, DC); Peverley, J. R.; Alexander, E. Phys. Lett.; 44A: No. 4, 298-300(18 Jun 1973).

The detection of magneto-acoustic oscillations in niobium is reported both for longitudinal and transverse waves. The data suggest the dominance of oscillations associated with the distorted ellipsoids of the third Brillouin zone. 3 figures. (auth)

Radiation Effects

Refer also to abstract 29198.

27877 (BARC-661) FAST NEUTRON DAMAGE IN STAINLESS STEELS. Agarwala, R. P.; Pande, B. M.; Anand, M. S.

(Bhabha Atomic Research Centre, Bombay (India)). 1972. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

During the normal working cycle of a fast reactor, steels used for cladding the fuel elements will be subjected to a fast neutron flux of the order of 10^{24} n/cm^2, corresponding to a normal-operation period of 3 years. Under high flux the steels develop voids. The formation of voids and their growth process are discussed. Several empirical relations connecting $\Delta V/V$ (% vol increase) with the flux are given. Calculations are made for $\Delta V/V$ as a function of flux at different temperatures from these relations and plotted. It is pointed out that these relations be used with some caution when extrapolating $\Delta V/V$ to fluence higher than 10^{23} nvt. (auth)

27878 (IAE-2198) FRENKEL PAIR ACCUMULATION VELOCITY AT REACTOR IRRADIATION. Al'tovskii, I. V. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 11p. (In Russian). INIS.

A calculation was made of the accumulation rate of defects in materials, taking into consideration the radiation annealing of Frenkel pairs. The number of secondary displacements, formed by each initially knocked-out atom, is reduced because of the migration and annihilation of Frenkel pairs in the area of cascade evolution. This makes it possible to obtain agreement of the theoretical and experimental magnitude of the accumulation rate of defects during reactor irradiation. (tr-auth)

27879 (IAE-2199) DEFECT CROWDING AT RADIATION ANNEALING OF FRENKEL PAIRS. Al'tovskii, I. V.; Platonov, P. A. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 18p. (In Russian). INIS.

During the reactor neutron irradiation, the initially knocked-out atoms, forming secondary defects and being slowed down, release their energy in the zone of cascade evolution which, being heated to temperatures higher than the temperature of the medium, causes the migration of Frenkel pairs, their annihilation, and also, and a consequence of the strong supersaturation of the defects, their agglomeration. A differential equation in partial derivatives according to time and according to the multiplicity of the defect accumulation was given. It describes the kinetics of the formation of the accumulation. The solution of the equation gives the dependence of the concentration and the accumulation multiplicity on the original energy of the slowed-down atom. Expressions were obtained for the number of accumulations formed in the original material in the case of the formation of loop dislocations and in the case of spherical vacancy accumulations, stabilized by gaseous products of nuclear reactions. (tr-auth)

27880 (NIIAR-P-145) DYNAMICS OF RADIATIVE DAMAGE AT HYPOTHETIC 0°K. (Programs Collection. 1). Kirsanov, V. V.; Osipova, Z. Ya. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 27p. (In Russian). INIS.

Programs permitting the EVM simulation of the process of the dynamics of radiation damage in crystals at low temperatures were given. In each program a block diagram, a description of the magnitudes introducible in the calculating time, and the magnitudes obtainable as a result of the solution were given. All programs were written in the alpha language. With this paper the authors begin publication of a complex program on the machine simulation of radiation damage. (tr-auth)

27881 (NIIAR-P-146) DYNAMICS OF RADIATION DAMAGE IN A WIDE TEMPERATURE RANGE OF AN IRRADIATED CRYSTAL. Kirsanov, V. V.; Osipova, Z. Ya. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 33p. (In Russian). INIS.

Programs permitting the EVM simulation of the dynamics of radiation damage in a wide interval of temperatures for irradiated crystals were given. In each program a block diagram, description of the magnitudes introducible in the calculation time, and magnitudes obtainable as a result of the solution are given. All programs are written in alpha language. (tr-auth)

27882 (NIIAR-P-147) SIMULATION OF STRUCTURAL DEFECTS AND RADIATIVE DAMAGE DYNAMICS PROCESSES IN A DEFECTED CRYSTAL. (Programs Collection. 3). Kirsanov, V. V.; Osipova, Z. Ya. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 33p. (In Russian). INIS.

Programs permitting the EVM simulation of the structural defects of crystals (vacancies, intrusions, and their complexes) of the dynamics of radiation damage in defective crystals are given. In each program a block diagram, a description of the magnitudes introducible in the calculation time, and magnitudes obtainable as a result of the solution are given. All programs are written in alpha language. (tr-auth)

27883 (NIIAR-P-154) ENERGY AND ENTROPY OF MIGRATION OF DEFECTS ORIGINATED IN α PLUTONIUM UNDER NEUTRON IRRADIATION. Raetskii, V. M. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 30p. (In Russian). INIS

Measurements of the electric resistance and length of α-Pu during neutron irradiation in liquid nitrogen and during subsequent annealing are reported. Results on isothermal and isochronous annealing in the first stage $80 < T < 150$°K are better described under the assumption of second-order reactions. E and the entropy $S < O$ of activation of annealing of the defects were determined. The sizes of E and S depend on the concentration of the defects. Empirical relations describing the dependence of these sizes on the changes of the electric resistance $\Delta R/R$ are given. Comparative data on the change of the annealing temperature of the defects, arising in α-Pu during neutron irradiation at 77°K (the present results), and during self-irradiation at 4.5 and 20°K (literature data), are given. A relation determining the rate C of the migration of the defects in the crystals is proposed. The magnitude C appears similar for annealing defects in the first stage in α-Pu, Cu, Ag, Au, and Al, as well as for annealing vacancies in Cu. An empirical relation for the determination of the free energy of migration is deduced. The entropy of activation $S_1 < O$ was evaluated in the elastic approximation. It was found that the interaction of the defects with neighboring atoms is significantly affected by the size of the entropy of the defect migration in the first stage in α-Pu. (tr-auth)

27884 (NIIAR-P-163) MACROSCOPIC MODEL OF IRRADIATED SOLID SWELLING. Ivanov, L. D. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 18p. (In Russian). INIS.

The phenomenon of swelling, observed in reactor construction materials, was analyzed by the method of theory of internal stress. It was found that the effect is caused by the presence of elastic and plastic deformations. Plastic deformations are accompanied by the formation of a break of the continuity, originating as a result of the nonconservative motion of the dislocation. The possibility of using x-ray data for evaluation of the swelling is discussed. (tr-auth)

27885 (WASH-1240-73) CRITICAL QUESTIONS IN RADIATION EFFECTS RESEARCH. Summary of a Meeting Held at AEC-Germantown, Maryland, December 5–6, 1972. Ianniello, L. C. (comp. and ed.) (Division of Physical Research (AEC), Washington, D. C.). Apr 1973. 98p. Dep. NTIS $7.00.

A meeting was held to focus in on problem areas and identify priorities in the field of radiation effects research. Both applied problems and fundamental radiation research are considered. Despite the diversity of opinion expressed throughout the report, a number of common critical questions emerge. Among those discussed are the questions of dynamic mechanical properties during irradiation, the equivalence of various irradiations, the generalization of current understanding to all classes of metals, and theoretical bases for understanding the relationship between properties and radiation-induced defects. (auth)

27886 SYMMETRIC WEAK BEAM METHOD AND ITS APPLICATION TO DISLOCATION LOOP ANALYSIS. Kelly, P. M.; Blake, R. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Phil. Mag.; 28: No. 2, 475-480 (Aug 1973).

The potential of the "weak beam" technique in the analysis of dislocation loops was investigated. A new variant of the technique—the "symmetric weak beam" method—was developed. This produces dislocation images approaching those of the conventional "weak beam" technique, but in addition allows the formation of a "symmetric weak beam bright field" (SWBBF) micrograph where dislocation loop images coincide with the true loop position. The advantages of the "symmetric weak beam" method are discussed in terms of its application to the analysis of loops in irradiated titanium. (auth)

27887 EFFECT OF NEUTRON-IRRADIATION DAMAGE ON LOW-TEMPERATURE DEFORMATION CHARACTERISTICS OF BCC METALS AND THEIR ALLOYS. Arsenault, R. J.; Kuo, K.; Huang, Y. (Univ. of Maryland, College Park). pp 48-57 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

The effect of neutron damage on the thermal component of the flow stress (τ^*) of bcc metals is strongly influenced by the amount of impurity interstitials in the metal. The dislocation channeling occurs in all the V–O alloys, but dislocation structure changes, i.e., the density of dislocations within and near the channels, increases as the O_2 concentration increases. However, the dislocation tangles which form at the intersection of the channels appear to control the rate of work hardening. (13 figures) (auth)

27888 RELAXATION SPECTRA OF NIOBIUM IRRADIATED AT LOW TEMPERATURE. Igata, N. (Tokyo Univ.); Kohyama, A.; Miyahara, K.; Sato, S.; Yoshida, H. pp 58-65 of Mechanical Behavior of Materials. Vol. I. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P1.

For annealed or cold-worked niobium specimens, internal friction was measured from liquid helium temperature or liquid nitrogen temperature to room temperature, before and after irradiation. The relaxation spectra of α', α, and β peaks were observed. α' and α peaks were suppressed, but β peaks grew by self interstitials after Stage I anneal. α' and α peaks may be analyzed as the screw-wise kink motion and the kink pair formation of non-screw dislocations, respectively. The β peak can be interpreted as a Hasiguti peak similar to that of fcc metals. The relationship between yield strength and these peaks is discussed. (auth)

27889 METHOD FOR DETECTING EMBRITTLEMENT OF METALS DUE TO VARIOUS CAUSES. Oku, T.; Usui, T. (Japan Atomic Energy Research Inst., Ibaraki). pp 398-406 of Mechanical Behavior of Materials. Vol. V. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P5.

The method is based on the temperature dependence of Vickers hardness. In this method the ductile-brittle transition temperature (DBTT) is defined as the junction point in the logarithm of Vickers hardness vs the reciprocal of absolute temperature. As the basis of the method, correlation among the DBTT's by tensile, compressive, hardness, and Charpy impact tests is discussed. Experimental correlation was comparatively consistent with that expected from theory. Data are given for Mo and W. This method was applied to radiation embrittlement of a pressure-vessel steel and prestraining embrittlement of a mild steel. Correlation of hardening with embrittlement was easily obtained by applying this method. (auth)

27890 PREDICTION OF ION-BOMBARDED SURFACE TOPOGRAPHIES USING FRANK'S KINEMATIC THEORY OF CRYSTAL DISSOLUTION. Barber, D. J. (Essex Univ., Colchester, Eng.); Tsong, I. S. T.; Frank, F. C.; Moss, M.; Steeds, J. W. J. Mater. Sci.; 8: No. 7, 1030-1040 (Jul 1973).

The two kinematic theorems of crystal dissolution by Frank are applied to surfaces undergoing ion-bombardment (sputtering) in order to determine the topographies evolved in any given time. The predicted shapes show good agreement with experimental observations. (auth)

27891 RESISTIVITY CHANGES IN NEUTRON-IRRADIATED ZIRCONIUM AT 77K. Rosenbaum, M. (CNEA, Buenos Aires); Bisogni, E. A.; Blewitt, T. H. J. Nucl. Mater.; 48: No. 2, 201-203 (Sep 1973).

Irradiations of 99.99% Zr wires were carried out in the RA-1 reactor under a flux of 10^{12} n cm^2/s (E > 1 MeV). The variation in the resistivity ρ upon irradiation was measured in situ, and then the samples were withdrawn and stored at 77°K to allow decay of the radioactivity, followed by measurements of the recovery during isochronal pulse annealing. A plot of $\Delta\rho$ vs irradiation time (up to 100 h) show a slight curvature down from the linear dependence, indicating some radiation annealing. The $d\Delta\rho/dt$ vs $\Delta\rho$ plot obeys the equation $d\Delta\rho/dt = A(1 - \alpha\Delta\rho)$, except for very short irradiation times. The extrapolated saturation value of the resistivity increment is 2.4×10^{-6} ohm · cm, and a saturation concentration of Frenkel pairs $C^+ = 2.5 \times 10^{19}$ pairs/cm^3 and a spontaneous recombination volume of Frenkel pairs $V_c = 840$ atomic volumes are obtained. After a dose of 3.6×10^{17} n/cm^2 (E > 1 MeV), the concentration of Frenkel pairs is $\sim 2 \times 10^{-4}$ atomic fraction, about 1/3 of the Kinchin-Pease prediction, indicating self-annealing. Three recovery stages were observed: stage I (100-130°K), where 30% of the induced resistivity anneals out and where long-range migration of interstitials occurs; stage II (130-250°K); and stage III (250-300°K). (DLC)

27892 STRESS-BIASED LOOP NUCLEATION IN IRRADIATED TYPE 316 STAINLESS STEEL. Okamoto, P. R.; Harkness, S. D. (Argonne National Lab., IL). J. Nucl. Mater.; 48: No. 2, 204-206 (Sep 1973).

In order to determine whether stress during irradiation changes the interstitial loop distribution, measurements were made of loop-size distributions developed in a pressurized capsule of solution-annealed Type 316 stainless steel which was irradiated in the EBR-II to a fluence of 2.4×10^{21} n/cm^2 (E > 0.1 MeV) at 410°C under a loop stress of 30 ksi. The Frank-loop size distribution on each set of {111} planes were measured separately using fine-structure diffraction. The average loop size was found to be the same, within 5%, on all four sets of {111} planes, but the concentration of loops varied by a factor of ~2, supporting Brailsford and Bullough's suggestion that stress-biased loop nucleation is an important mechanism for radiation-enhanced creep. (DLC)

27893 EQUILIBRIUM SHAPE OF GAS-FILLED VOIDS IN A SOLID. Frank, F. C. (Univ. of Bristol, Eng.). J. Nucl. Mater.; 48: No. 2, 199-200 (Sep 1973).

The available volume for a void is enhanced by elastic expansion of the cavity. For a given pressure, the elastic expansion is much greater for a thin flat cavity than for a compact quasispherical cavity of the same volume in the absence of elastic deformation. It is shown that thin flat cavities give the lowest free energy if a finite positive gas pressure is maintained in them; however, unless the pressure is high, a high activation energy will prevent the transformation of a compact cavity to this more-stable configuration. Once nucleated, the flat cavity would grow by attracting vacancies at its edges. (DLC)

27894 COMPARISON OF 16-MeV PROTON, 14-MeV NEUTRON, AND FISSION-NEUTRON DAMAGE IN COPPER. Mitchell, J. B.; Logan, C. M.; Echer, C. J. (Univ. of California, Livermore). J. Nucl. Mater.; 48: No. 2, 139-142 (Sep 1973).

The irradiation damage structures produced in high-purity copper by a fluence of 3×10^{16} particles/cm^2 of 16-MeV protons, 14-MeV neutrons, and fission neutrons (E > 1 MeV) were studied by transmission electron microscopy. The damage consists of vacancy-and-interstitial clusters or sessile Frank dislocation loops oriented on {111} planes of the copper matrix, and ranges in size from 25 Å {lower limit of resolution} to 200 Å in diameter. The size-density distributions of the clusters in the 14-MeV neutron and 16-MeV proton-irradiated samples were virtually identical, and the average size of the clusters in these two groups of specimens was substantially larger than was the case for those in the fission-neutron-irradiated copper. (auth)

27895 HELIUM BUBBLE FORMATION AND MIGRATION IN NIOBIUM. Aitken, D.; Goodhew, P. J.; Waldron, M. B. (Univ. of Surrey, Guilford, Eng.). Nature (London) Phys. Sci.; 244: No. 131, 15-16 (2 Jul 1973).

It is stated that, in the course of an investigation of the behavior of He bubbles in Nb after α-particle irradiation, considerably higher values for surface diffusion coefficients were found than in previous estimates. Preliminary conclusions are outlined, and more extensive experimental work is in progress. In the experiments described, pure Nb sheet was α-irradiated to a dose of 5×10^{20} ions/cm^3. Implantation was carried out at several ion energies to create a wide band of He in the thin-sheet specimens, and post-irradiation annealing was carried out at a range of temperatures from 850 to 1450°C for times of 0.25 to 100 hr. A controlled thickness was then removed from the surface by anodizing and stripping and the foil electropolished from the nonirradiated side. Bubble-size distribution was determined by transmission electron microscopy. In specimens annealed for only a short time there were indications that certain bubble sizes occurred more frequently than others. This is explained if the growth of bubbles in the observed size range occurs almost solely by migration and coalescence, rather than by diffusion of He between individual bubbles. Van der Waals' equation was used to calculate equilibrium bubble size at the appropriate gas pressure, rather than the ideal gas law. It is concluded that, in the regimes so far studied, He bubbles grow from a minimum size of 3.8 nm by a migration and coalescence mechanism, and that a surface diffusion mechanism operates. Bubble mobility was found to be at least two orders of magnitude higher than previously calculated. This high mobility may be a feature of some bcc metals, and has also been found for He bubbles in bcc Fe subjected to a temperature gradient. (UK)

27896 THEORY OF DISLOCATION-CREEP FOR A MATERIAL SUBJECTED TO BOMBARDMENT BY ENERGETIC PARTICLES. Gittus, J. H. (United Kingdom Atomic Energy Authority, Salwick, Eng.). Phil. Mag.; 28: No. 2, 261-270 (Aug 1973).

Development of a theory for the creep-rate ($\dot{\epsilon}_{ij}$) of materials under stress (σ_{ij}) during bombardment with energetic particles is continued. The equation $\dot{\epsilon}_{ij} = 1.5\ \sigma'_{ij} b \psi_d / I$ is arrived at where ψ_d is the random component of the dislocation-flux (intersections $m^{-1}\ s^{-1}$) and I an associated internal stress. Experimental and theoretical values of ψ_d and I are derived and compared for stainless steels and uranium. (auth)

27897 CHARACTERIZATION OF DISLOCATION LOOPS IN NEUTRON-IRRADIATED ZIRCONIUM. Kelly, P. M.; Blake, R. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Phil. Mag.; 28: No. 2, 415-426 (Aug 1973).

Dislocation loops formed in zirconium after neutron irradiation and subsequent annealing between 450 and 500°C are not pure

edge loops. A general method for analysing such loops by transmission electron microscopy is discussed briefly, and a technique for determining the loop plane normal to within ±5° is described. The Burgers vectors of the loops in annealed irradiated zirconium are found to be of the type a/3 (11$\bar{2}$0), while the loop plane normal is tilted by up to 35° towards the adjacent [2021] pole. Two thirds of the loops present after annealing at 490°C are vacancy loops, while the remainder are interstitial. Zirconium irradiated at 300°C and not annealed also shows only loops with a/3(11$\bar{2}$0) Burgers vectors. The significance of these results in interpreting previously reported irradiation growth data is briefly discussed. (auth)

27898 ELECTROPLASTIC AND RADIATION-PLASTIC DEFORMATION OF METAL. Troitskii, O. A.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 6, 1388-1391(21 Jun 1973). (In Russian).

The creep of crystalline zinc was investigated at liquid nitrogen temperatures with the simultaneous application of electrons by current flow and by irradiation. The zinc samples were 16 mm long with a diameter of ~1 mm. Copper leads were attached to the ends of the zinc crystals to supply current. Creep was brought about by the use of a constant stress in steps of 25 g. The time of creep was 10 min. Creep deformation was fixed by an electromechanical converter with an accuracy of 0.2%. The creep rate was determined as an average of the last 9 minutes of deformation. The flux of 0.55-MeV electrons was 1.16×10^{15} electrons/cm^2. The creep rate was found to increase as a result of irradiating the zinc crystals with electrons. During irradiation the zinc samples were oriented with the slip elements along the particle beam. After application of a critical stress, substantial plastic deformation is observed. This effect was a factor of two larger for irradiated samples than for the unirradiated samples. The critical stress was also lower by 30% for the irradiated samples as compared to the unirradiated samples. The probability of brittle fracture is smaller in irradiated zinc. The combined application of radiation and current leads to an increase of more than double in the effect as compared to the use of only irradiation or only current. A creep mechanism involving the intersection of dislocations is presented. (SJR)

Other Materials

Refer also to abstracts 27078, 27089, 27091, 27830, 27878, 27879, 27890, 27893, 28207, 29546, and 29551.

27899 (DP-MS-71-86) MOESSBAUER SPECTRA AND MAGNETIC PROPERTIES OF Cs_2NpCl_6, $(TMA)_2NpCl_6$, AND $(TEA)_2NpCl_6$. Stone, J. A.; Karraker, D. G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 10 Feb 1972. 15p. (CONF-720353-2). Dep. NTIS $3.00.

From meeting of the American Physical Society; Atlantic City, New Jersey, USA (27 Mar 1972).

The cesium, tetramethylammonium (TMA), and tetraethylammonium (TEA) salts of octahedral $NpCl_6^{--}$ were studied by ^{237}Np Moessbauer spectra and magnetic susceptibility measurements from 2.5 to 70°K. The data are consistent with the assignment of a Γ_8 quartet as the ground level of Np^{4+} ($J = 5/2$) in each compound. From the susceptibilities, the Γ_8 ground levels of Cs_2NpCl_6 and $(TEA)_2NpCl_6$ are slightly distorted with 5 to 10 cm^{-1} splitting; $(TMA)_2NpCl_6$ is not split. The Moessbauer spectra exhibit paramagnetic hyperfine structure at 4.2°K, becoming single lines above 20°K; the spectra at 4.2°K have the following features: Cs_2NpCl_6 — a very broad, unresolved resonance; $(TMA)_2NpCl_6$ — anomalous spectrum, possibly reflecting the unusual properties (anisotropic hfs, quadrupole interaction) of Γ_8 levels predicted by Bleaney; $(TEA)_2NpCl_6$ — magnetic and quadrupole splitting, with nonzero asymmetry parameter, indicating that the Γ_8 distortion is of symmetry lower than trigonal. (auth)

27900 (JAERI-M-5245) PHYSICAL PROPERTIES OF GRAPHITE AND ITS THERMAL NEUTRON SCATTERING CHARACTERISTICS. Nakahara, Y. (Japan Atomic Energy Research Inst., Tokyo). Apr 1973. 65p. (In Japanese). NTIS (U.S. Sales Only).

Theoretical and experimental studies of the physical properties and thermal neutron scattering characteristics of graphite moderator are reviewed from the point of view of reactor physics, and calculations are also summarized. The descriptions, including discussions, include the following: the structure and properties of graphite, theoretical methods to analyze the lattice vibration of atoms in crystalline graphite, theoretical and experimental values of the frequency distribution, computational methods for the thermal neutron scattering cross sections, computer codes, data libraries and the computed and measured values of the scattering cross sections. (auth)

27901 (JAPFNR-119) FUEL MONITORING FACILITY (FMF). (Power Reactor and Nuclear Fuel Development Corp., Oarai (Japan). Oarai Engineering Center). Mar 1973. 45p. (PNC-N-964-73-1). Dep. NTIS (U. S. Sales Only) $4.25.

As part of the liquid metal fast breeder reactor development program of Japan, the JOYO experimental fast reactor is expected to attain criticality in 1974. The Fuel Monitoring Facility (FMF) will provide a hot cell and support areas and equipment for the postirradiation nondestructive examination of subassemblies and fuel pins from JOYO. Design layout and planned operation of the facility are presented. (TFD)

27902 (NP-19856) CONCRETE FOR PRESTRESSED CONTAINMENTS TESTS FOR CREEP AND SHRINKAGE USING FLY ASH CONCRETE. Topical Report No. 0-7040. (Tennessee Valley Authority, Knoxville). 1 May 1973. 75p.

Parallel tests were conducted on the fly ash concrete at Waterways Experiment Station and Singleton Materials Laboratory. Properties measured include compressive strength, modulus of elasticity, creep, and drying shrinkage vs time. Design values which should be used are discussed. (DLC)

For abstracts of individual papers see: 27744, 27745, and 27904.

27903 MECHANICAL BEHAVIOR OF MATERIALS. Volume IV. Concrete and Cement Paste; Glass and Ceramics. Proceedings of the International Conference, Kyoto, Japan, August 15–20, 1971. Kyoto; Society of Materials Science (1972). 516p. (CONF-710851-P4).

35 papers discuss the cracking and fracture of concrete and cement paste. 16 papers cover the mechanical behavior of glass and ceramics. Separate abstracts were prepared for three papers. (DLC)

27904 EFFECT OF MOISTURE CONTENT ON THE MECHANICAL BEHAVIOR OF CONCRETE EXPOSED TO ELEVATED TEMPERATURES. Polivka, M.; Bertero, V. V.; Gjorv, O. E. (Univ. of California, Berkeley). pp 203-213 of Mechanical Behavior of Materials. Vol. IV. Kyoto; Society of Materials Science (1972).

From international conference on mechanical behavior of materials; Kyoto, Japan (15 Aug 1971). See CONF-710851-P4.

Concrete specimens were exposed either to thermal cycles of 70–300–70°F or to a sustained temperature of 300°F. During these thermal exposures, varying amounts of moisture were permitted to escape from the concrete. The moisture condition of the concrete during thermal exposure has a significant effect on its mechanical characteristics. A maximum loss of about 75% in strength and 55% in modulus of elasticity was obtained for a concrete which lost ~50% of its free water. When most of the moisture escaped early during the thermal exposure, however, the mechanical properties were not significantly affected. Thermal cycling produced permanent expansions of the concrete. The higher the moisture content of the concrete, the larger its residual expansion. (auth)

27905 RESIDUAL HYDROCARBON AND HYDROGEN CONTENTS OF CARBONS AND GRAPHITES. Meyer, R. T. (Sandia Lab., Albuquerque, NM); Lynch, A. W.; Freese, J. M.; Smith, M. C.; Imprescia, R. J. Carbon; 11: No. 3, 258-262(Jun 1973).

Various experimental techniques, which include time-resolved mass spectrometry, laser-induced vaporization, combustion gravimetry, and x-ray powder diffractometry, were used to determine the residual hydrocarbon and hydrogen contents of carbons and graphites. Three results are reported: the evolution of amounts of hydrogen from pulse-laser-heated graphite that equal or exceed the amount of C vaporized as Cn species, the measurement of residual hydrogen contents of several commercial graphites, and a correlation between heat treatment and residual hydrogen content for three different formulations of carbon/graphite. Hydrogen contents ranged from 100 to 1000 ppM in the carbons and 5 to 200 ppM in the graphites. (UK)

27906 STRESS DEPENDENCE OF HIGH-TEMPERATURE SWELLING. Brailsford, A. D.; Bullough, R. J. Nucl. Mater.; 48: No. 2, 87-106(Sep 1973).

The existence of unstable stress-assisted swelling in irradiated materials is predicted and the physical parameters that determine the critical dose for the onset of this swelling are exposed. The detailed form of the swelling as a function of displacement damage is computed for a range of the relevant variables using an extension of the rate theory previously developed for swelling in the absence of external stress. It is suggested that experimental verification of the phenomenon should be sought and that the present analysis can guide the choice of appropriate experimental conditions. (17 figures) (auth)

27907 CHANGES IN YOUNG'S MODULUS OF NEUTRON-IRRADIATED REACTOR-GRADE GRAPHITE BY THERMAL

ANNEALING. Matsuo, H.; Honda, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 48: No. 2, 207-209 (Sep 1973).

A study was made of the effects of thermal annealing on the Young's modulus of polycrystalline graphite irradiated at 250°C (7.49×10^{20} nvt thermal) and 350°C (1.82, 7.54, and 17.0×10^{20} nvt thermal). The modulus decreases rapidly with annealing at annealing temperatures of 30 to 500°C, and the change is independent of irradiation temperature, but beyond 500°C the change depends inversely on irradiation temperature. (DLC)

27908 PROCESSES OCCURRING IN THE SURFACE REGION OF CdS SINGLE CRYSTALS UNDER ELECTRON BOMBARDMENT, PHOTOEXCITATION, AND GAS ADSORPTION AND THEIR ROLE IN THE 80°K-EXCITON PHOTOLUMINESCENCE. Cherednichencko, A. E.; Novikov, B. V.; Benemanskaya, G. V. (Leningrad State Univ.). J. Lumin.; 6: No. 3, 193-205(Apr 1973).

Investigations were carried out on the effect of 3- to 5-keV electron irradiation, intense photoexcitation, and gas adsorption on photoluminescent spectra of CdS single-crystal platelets. CdS platelets subjected to electron bombardment were found to be very active for gas adsorption. The bound exciton emission is influenced by oxygen. A detailed study of the effect of the electron bombardment on the photoluminescence spectra is presented. Results indicate that correlation can be made between the behavior of the electron bombardment-induced bound exciton emission and the electron processes occurring in the surface region of CdS single crystals. The changes in the photoluminescent spectra caused by the electron bombardment, followed by room-temperature photoexcitation, were interpreted in terms of surface photochemical effects. (6 figures, 36 references) (auth)

27909 METHOD FOR THE PREPARATION OF ZIRCONIUM, HAFNIUM, AND THORIUM ALKOXIDES. Hoch, M. U. S. Patent 3,754,011. 21 Aug 1973. Filed date 28 Oct 1970. 12p.

A method is described for preparing metal alkoxides of hafnium, zirconium, and thorium in high yields and particularly adapted for large-scale operations. The method involves a preparation of metal isopropoxides of the selected metal by the reaction of a metal tetrahalide with isopropyl alcohol under controlled alkaline conditions to form the desired metal tetraisopropoxide in high yields. The metal tetraisopropoxides are then reacted with secondary or tertiary alkanols heavier than isopropanol by alcoholysis exchange to produce the metal tetra secondary or tertiary alkoxides. The metal tetraalkoxides produced are useful as precursor materials in the preparation of fine powders, films, and coatings of zirconium, hafnium, and thorium oxides in high purity by thermal decomposition. The metal oxides are useful in forming high temperature ceramic bodies, oxidation-resistant coatings, absorbants, catalysts, and the like. (Official Gazette)

27910 EFFECT OF 80-keV Ne^+ ION IMPLANTATION ON ACOUSTIC SURFACE WAVE ATTENUATION IN $LiNbO_3$. Larson, T. R.; Weisenberger, W. H.; Lucke, W. H. (Naval Research Lab., Washington, DC). Appl. Phys. Lett.; 22: No. 12, 617-618(15 Jun 1973).

Acoustic surface wave attenuation in $LiNbO_3$ caused by ion implantation was studied as a function of fluence and surface wave frequency. 80-keV Ne^+ ions were implanted at five fluences covering the range 10^{14} to 10^{16} ions/cm^2. The yz Rayleigh surface waves were generated, spanning the interval 100 to 1000 MHz by interdigital transducers operating at odd harmonics. Attenuation was measured directly by a standard laser probe using reflected light. At low acoustic power densities, the data can be fit by $P(z)/P_0 = 10^{-Af^2z}$, where P is acoustic power, f is the surface wave frequency, and A is a constant for each fluence used. The values of A show a definite peak with fluence at around 10^{15} ions/cm^2, where $A = 9 \times 10^{-5}$ dB cm^{-1} MHz$^{-2} \pm 10\%$. This is about twenty times the value of A for an unimplanted surface. (auth)

27911 FUSIBILITY DIAGRAM OF THE $KCl-UCl_3-UF_4$ SYSTEM. Desyatnik, V. N.; Katyshev, S. F.; Raspopin, S. P.; Trifonov, I. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 2, 132-134(1973). (In Russian).

By the method of differential thermal analysis, the surface of the primary crystallization of the $KCl-UCl_3-UF_4$ system was studied. Three eutectic and three peritectic points were established. (tr-auth)

27912 RADIATION EFFECTS ON CRYSTALS OF AMMONIUM DIHYDROGEN PHOSPHATE. Motoc, C.; Teodorescu, G.; Cone, G. (Institutul Politehnic, Bucharest). Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucuresti; 35: No. 2, 37-41(1973). (In Rumanian).

Microstructural changes in ammonium dihydrogen phosphate irradiated with 60-keV electrons are examined. It is shown that some of the induced defects are similar to those encountered in alkali metal halides irradiated with electrons or heavy particles. The effect of local heating due to the electron beam is discussed in order to account altogether with other mechanisms for the induced defects. (auth)

27913 MELTING BEHAVIOR OF IRRADIATED POLY(VINYLIDENE FLUORIDE). I. Radiation Effects on Polyvinylidene Fluoride. Suwa, T.; Seguchi, T.; Makuuchi, K.; Abe, T.; Tamura, N. (Japan Atomic Energy Research Inst., Takasaki). Nippon Kagaku Kaishi; 1973: No. 5, 1046-1051(May 1973). (In Japanese).

The melting and crystallization behavior of poly(vinylidene fluoride) (PVdF) before and after irradiation was observed by the use of a differential scanning calorimeter (DSC). Gamma irradiation was carried out with ^{60}Co at a dose rate of 1 MR/hr at ambient temperature. Electron beam irradiation was carried out with EBG at 2 MeV and at a dose rate of 2 MR/pass by intermittent irradiation to prevent a rise in temperature by means of a shuttle conveyor. Melting temperature (T_m) and crystallization temperature (T_c) were measured at the peak in the DSC thermograms. T_m decreased with increasing radiation dose. PVdF, irradiated in vacuum, gave mostly a simple and sharp peak. On irradiation in air, more complex peaks were observed. These results indicate that the melting behavior is strongly affected by the presence of oxygen during the irradiation. Depressions of T_m and T_c were the same for gamma and electron irradiation in vacuum. On the other hand, T_m depression of PVdF by irradiation in air was smaller than that in vacuum, and a difference in melting point depression between gamma and electron irradiation was also observed. The peak at higher temperature corresponds to crystalline state where the degradation due to irradiation is mainly produced by the presence of sufficient oxygen near the film surface. The peak at lower temperature corresponds to crystalline phase where crosslinking mainly takes place by irradiation in the absence of oxygen at inner parts of the film similar to the vacuum irradiation. When crosslinks are introduced, defects would be produced in the crystalline lattice. The defects would cause a melting point lowering, the magnitude of which is larger than that produced by the scission of molecular chain in the crystalline phase on irradiation in air. Both heat of fusion and crystallinity decreased with increasing radiation dose. About 17% decrease of heat of fusion was observed after 200-MR irradiation. On the other hand, x-ray diffraction profiles did not change markedly. The decrease in the crystallinity, determined from x-ray diffraction, was 7%. (auth)

27914 EFFECTS OF IMPURITIES ON GAMMA-IRRADIATED SILICON CRYSTAL EXAMINED BY PHOTOVOLTAIC EFFECT OF p–n JUNCTION DIODE. Yamaguchi, M.; Nagai, O. (Ibaraki Electrical Communication Lab., Tokai, Japan). Jap. J. Appl. Phys.; 11: No. 7, 1016-1023(Jul 1972).

Minority carrier lifetime in ^{60}Co gamma-irradiated silicon bulk crystals is examined by photovoltaic effect of silicon p–n junction, and following results are disclosed. (1) Damage constant, K, increases with impurity concentration of bulk crystals. K is smaller in p-type crystals than in n-type. (2) For isochronal annealing, recovery stages of n-type bulk crystals at 100 to 150°C and 300°C are found. In p-type crystals, reverse annealing is observed at 200 to 300°C. (3) From the temperature dependence of carrier lifetime, energy levels of the recombination centers at $E_c - 0.42$ for n-type and $E_v + 0.32$, $E_v + 0.25$ eV for p-type crystals are found. (4) Recovery stage of p-type bulk crystals due to gamma irradiation at 81°K is observed at about 150°K, but that of n-type is not observed between 80 and 300°K. (5) The lifetime degradation in p-type crystals due to gamma irradiation at 81°K is reduced when minority carrier is injected after the irradiation. (auth)

27915 ELECTRON NUCLEAR DOUBLE RESONANCE IN ELECTRON-IRRADIATED MgF_2. Nelson, L. G. Athens, OH; Ohio Univ. (1973). 158p. University Microfilms Order No. 73-19,062.

Thesis (Ph. D.).

Measurements were made at liquid nitrogen temperature using an ENDOR spectrometer sweeping the frequency interval between 0.2 and 220 MHz. The presence of an F center resonance was conclusively demonstrated in electron-irradiated MgF_2, and hyperfine constants were measured for the sixteen nearest neighboring fluorine nuclei. The EPR envelope is symmetric about $g = 2$ and the resolvable structure is fully accounted for by the three strongest of the six sets of unequal fluorine hyperfine interactions measured. No ^{25}Mg hyperfine interactions were identified, and the remaining unidentified lines are either of very low intensity or are clustered within a seven-MHz interval centered upon the fluorine free nuclear frequency. Since the EPR envelope has been accounted for, there can be no strong ^{25}Mg interactions outside of the 220-MHz frequency interval measured, nor can there be any other paramagnetic resonances near $g = 2$ with an intensity comparable to that of the F center. A parallel EPR and optical

investigation by Kolopus, et al., at ORNL has confirmed that only one EPR spectrum is produced in MgF_2 crystals by electron, neutron, or gamma irradiation between 77°K and room temperature, and has demonstrated beyond doubt that the EPR spectrum and the 260 nm absorption in the optical spectra arise from the same source. These results together thus prove that the 260-nm line arises from an F center. (DLC)

27916 EFFECT OF ^{60}Co γ-RADIATION ON THE ^{125}Sb DIFFUSION, SOLUBILITY, AND NEAR-SURFACE DISTRIBUTION IN NaCl. Arakelyan, V. S.; Spitsyn, V. I.; Chinskii, E. B. (Inst. of General and Inorganic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 4, 884-887(1 Jun 1973). (In Russian).

NaCl samples 2.0 × 1.5 × 0.29 cm in size were cut from a single crystal and polished. Metallic ^{125}Sb with a specific activity of 10 mc/g was used in the diffusion experiments. Diffusion was carried out in an evacuated quartz ampoule set in a furnace. It was possible to irradiate the sample in a ^{60}Co gamma field. The diffusion temperature was varied from 500 to 727°C. In most cases the irradiation time exceeded the annealing time by about a factor of two. The distribution of ^{125}Sb was measured by successively removing layers of material and measuring the beta activity in the layer that was removed. In the surface region, the diffusion coefficient C is a linear function of the depth x. The diffusion coefficient was found to decrease as a result of irradiation in a ^{60}Co gamma field. Without irradiation, the diffusion coefficient is $D = 2.1 \times 10^{-8} \exp(-12{,}100/RT)$. The activation energy is E = 12.1 kcal/gram-mole = 0.52 ev. With radiation $D = 1.2 \times 10^{-8} \exp(-20{,}300/RT)$. (SJR)

27917 EFFECT OF THERMOELASTIC STRESSES ON MACROPORE DISTRIBUTION IN IRRADIATED LITHIUM FLUORIDE CRYSTALS. Feldmane, E. E.; Shvarts, K. K.; Podin, A. V. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 14-17(1973). (In Russian).

A study is made of macropore production in thermal neutron and electron-irradiated lithium fluoride single crystals at high temperature annealing. At absorbed doses up to 10^4 mrad, macropores are shown to be produced only under the action of thermal neutrons. In crystals (dislocation density 10^4 cm^2) irradiated by a 10^{17} n/cm^2 dose, a peculiar macroanisotropy distribution is found with respect to the volume which is due to thermoelastic stresses arising during the annealing. (auth)

27918 MAGNETIC PROPERTIES OF PLUTONIUM MONOARSENIDE. Blaise, A.; Fournier, J. M.; Salmon, P. (CEN, Grenoble, France). Solid State Commun.; 13: No. 5, 555-557(1 Sep 1973).

The static magnetization of PuAs was measured. It was found to be ferromagnetic with a Curie temperature of 129°K. The saturation moment is 0.35 μ_b and the effective paramagnetic moment deduced from the Curie–Weiss law is 0.97 μ_b. (auth)

27919 CHANNELING MEASUREMENTS OF DAMAGE IN LiF, NaCl, AND KCl. Hollis, M. J. (Australian National Univ., Canberra); Newton, C. S.; Price, P. B. Phys. Lett.; 44A: No. 4, 243-244(18 Jun 1973).

Experimental data indicating reduction in backscattered ion yield at high doses ($\gtrsim 10^{16}$ ions/cm^2) of 1-MeV He^+ ions in the ⟨100⟩ direction of LiF, NaCl, and KCl are presented. Possible mechanisms for this recovery are considered. (auth)

27920 X-RAY INVESTIGATION OF THE LATTICE PARAMETERS OF NpP AT LOW TEMPERATURE. Mueller, M. H.; Lander, G. H.; Knott, H. W.; Reddy, J. F. (Argonne National Lab., IL). Phys. Lett.; 44A: No. 4, 249-250(18 Jun 1973).

A low-temperature x-ray investigation of the antiferromagnetic compound NpP shows that the cubic unit cell becomes tetragonal when the magnetic structure becomes commensurate with the chemical lattice at 74°K. No anomaly in the lattice parameter is observed at the Neél temperature of 125°K. (auth)

27921 DEFECT FORMATION BY N^{++} ION BOMBARDMENT IN LiF AND NaF. Kubo, K.; Kazumata, Y.; Tomimitsu, H. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 34: No. 6, 1536-1540(Jun 1973).

The F-light absorption was measured in LiF and NaF single crystals bombarded by 0.7-MeV N^{2+} ions from a Van de Graaff accelerator. The growth curves showed a maximum, from which the F-center concentration at the saturation was estimated to be 7.6 and 3.8×10^{19} F-centers/cm^3 in LiF and NaF, respectively. The rates of production, 3020 and 1210 F-centers/N^{2+} ion, and the formation energies of an F-center, 232 and 578 eV, were determined from the initial portions of the growth curves in LiF and NaF, respectively. The formation of metallic film on the bombarded surface and other imperfections as the result of radiation damage are discussed, referring also to the micrographic observations. It is thus concluded that the damage by N^{2+} ions is fairly severe; the double charge is possibly responsible for this phenomenon. (auth)

27922 RADIATION-STIMULATED LUMINESCENCE OF CdF_2 CRYSTALS ACTIVATED BY IONS OF RARE EARTHS. Bakhidov, Sh. A.; Tavshunskii, G. A.; Kaipov, B. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 17-19(1972). (In Russian).

Characteristics of radiation-optical processes were studied in crystals of CdF_2–RE (RE = Nd, Sm, Eu, Ho, Er) at various concentrations of the RE activators at 308°K in a localized γ-radiation field; also, the crystals were subjected to annealing in Cd vapor. Photoluminescence was similarly investigated for the same samples. The spectra of γ-luminescence at 77°C manifested a blue–violet region with gaps in the region of absorption of the corresponding RE^{3+}. Luminescence bands and transitions are discussed for each of the RE elements under investigation. (KSW)

27923 RECOIL IMPLANTATION OF Ga IN Si BY Ar IONS. Wagh, A. G.; Sarma, N.; Sood, D. K.; Thampi, N. S. pp 521-524 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231–.

27924 RADIATION MODIFICATION OF POLYOLEFINES. Karpov, V. L.; Finkel, E. E.; Berlyant, S. M.; Braginskii, R. P. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 270-278(1973). (In Russian).

A review is presented with 87 references analyzing the effect of radiation on the changes in physico-mechanical and electric properties of polyethylene and other polyolefines as well as the thermal stabilization of the radiation modified polyolefines. The reported data suggest that radiation modification of polyethylene is one of the most promising radio-chemical processes. The polyethylene modified by radiation exhibits several novel qualities in comparison to the nonirradiated one, expanding considerably its applicability. The properties and areas of application of the products manufactured from radiation modified polyethylene is noted. (JPRS)

27925 GAMMA-RAY INDUCED CONDUCTIVITY IN INSULATING POLYMERS. VI. Okamoto, S.; Furuta, J.; Hiraoka, E. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 94-98(1972).

The temperature dependence of induced current of polyethylene during and after cobalt gamma-ray irradiation was measured. These measurements and data from Fowler and other workers are analyzed using a recombination model in photoconductive insulators and semiconductors. It is found that the temperature dependence of induced current depends on the drift mobility and induced current of polyethylene and is concerned with two different kinds of carriers. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

27926 (ANL-8029) EFFECT OF INDUCED FISSION ON PLUTONIUM ASSAY WITH A NEUTRON WELL COINCIDENCE COUNTER. Perry, R. B.; Brandenburg, R. W.; Beyer, N. S.; Gehrke, R. C.; Henderson, D. J. (Argonne National Lab., Ill.). Jun 1973. Contract W-31-109-eng-38. 11p. Dep. NTIS $4.00.

Results of an investigation of the neutron-multiplication effects in the Brookhaven neutron well coincidence counter designed for plutonium assay are reported. The study was initiated when anomalous results were obtained after calibrating the counter with samples of plutonium having various ^{240}Pu contents. The data with the cadmium-lined counter indicate that multiplication contributes to the coincident count in three ways: (1) source size variation from 2.5 to 40 g of ^{240}Pu in 10% ^{240}Pu causes 10 to 25% of the coincident neutrons to be from induced fission, (2) induced fission is strongly influenced by the relative position of samples in the counter well, and (3) neutron moderation in the source produces a 10% increase in gross count and a 4% increase in net coincident count. In extreme cases, if these multiplication effects are not taken into account, the apparent (i.e., measured) plutonium content can exceed the gross weight of the sample by more than a factor of two. (auth)

27927 (LA-UR-73-880) MEASUREMENTS OF UF_6 CYLINDERS WITH PORTABLE INSTRUMENTS. Walton, R. B.; Reilly, T. D.; Parker, J. L.; Menzel, J. H.; Marshall, E. D.; Fields, L. W. (Los Alamos Scientific Lab., N. Mex; Oak Ridge Operations Office (AEC), Tenn. Nuclear Materials Management Div). 1972. 39p. (CONF-730630-3). Dep. NTIS $4.00.

From 14th annual institute of nuclear materials management conference; San Diego, California, USA (20 Jun 1973).

The applicability of portable instruments for rapid nondestructive verification of the enrichment of UF_6 in cylinders was tested on a large number of types 30- and 5A-cylinders. Three basic techniques were used: gamma counting with NaI combined with ultrasonic measurement of cylinder wall thickness, passive neutron counting, and active neutron interrogation with thermal neutrons from a radioactive neutron source. The resulting accuracies and limitations of the techniques are presented. (auth)

27928 NUCLEAR FUEL ELEMENT IDENTIFICATION METHOD. Hunt, J. T. (to United States Atomic Energy Commission). U. S. Patent 3,747, 959. 24 Jul 1973. Filed date 21 Jul 1971. 4p.

Individual objects are identified within a multiplicity of the objects by an identification method which comprises establishing a first selected number of markable positions on each of the individual objects and placing a second selected number of identical identifying marks within the markable positions. The location of the second number of marks within the markable positions on each of the objects serves to identify that object within the multiplicity. (Official Gazette)

27929 STATISTICAL TERMINOLOGY OF NOTATION FOR NUCLEAR MATERIALS MANAGEMENT. New York; American National Standards Institute (1973). 8p. (ANSI-N15.5).

This standard deals with terminology and notation normally used in the statistical analyses of accountability data for nuclear materials management. One purpose of this standard is to define terminology used in the control of nuclear materials. The standard primarily emphasizes words and expressions which, on the one hand, are frequently encountered and, on the other hand, may have different meanings to different individuals. No attempt is made to compile a complete glossary of statistical terms. A second purpose of the standard is to define a few general rules on notation to permit easier communication. (auth)

27930 CLASSIFICATION OF UNIRRADIATED PLUTONIUM SCRAP. New York; American National Standards Institute (1972). 15p. (ANSI-N15.10).

This standard is intended to provide a classification system for scrap material containing recoverable amounts of plutonium. The inherent flexibility of the system will offer a means of facilitating activities in the nuclear industry related to the classification subjects herein identified. (auth)

27931 AMERICAN NATIONAL STANDARD FOR AUDITING NUCLEAR MATERIALS STATEMENTS. New York; American National Standards Institute (1973). 12p. (ANSI-N-15.11-1973).

A standard that may be used as a guide for persons making independent examinations of nuclear materials statements or reports regarding inventory quantities on hand, receipts, production, shipment, losses, etc. is presented. The objective of the examination of nuclear materials statements by the independent auditor is the expression of an opinion on the fairness with which the statements present the nuclear materials position of a nuclear materials facility and the movement of such inventory materials for the period under review. The opinion is based upon an examination made in accordance with auditing criteria, including an evaluation of internal control, a test of recorded transactions, and a review of measured discards and materials unaccounted for (MUF). The standard draws heavily upon financial auditing standards and procedures published by the American Institute of Certified Public Accountants. The reasons for this are twofold. First, the basic procedures of auditing are the same whether the units are monetary or physical and chemical. Second, the ANSI philosophy is to use existing authoritative standards wherever possible. Paraphrasing existing financial audit standards and procedures (which have been tested by years of practical application) to fit the specific requirement of nuclear materials would appear to be a reasonable extension of the ANSI philosophy. While the standard draws heavily upon financial auditing standards, it is not intended to be a guide for examination of financial statements nor for any other examination except those directly connected with nuclear materials statements. (auth)

27932 NUCLEAR MATERIAL CONTROL SYSTEMS FOR FUEL REPROCESSING FACILITIES (A GUIDE TO PRACTICE). Columbus, OH; Institute of Nuclear Materials Management (1973). 19p. (ANS-N15.13).

A standard is presented that establishes guidelines for control of nuclear material in aqueous fuel reprocessing facilities. Such facilities are those which process irradiated fuel from nuclear reactors to recover various materials from the fuels; in particular, source and special nuclear materials. The processing involved could include mechanical and chemical treatments to effect the separation of materials to be recovered from the unwanted fission products and other fuel assembly components and materials, and conversion of the recovered materials to other forms such as oxides or hexafluorides. The nuclear materials of interest for the purposes of this standard are the recovered uranium and plutonium. The normally expected forms for these recovered products include uranium or plutonium nitrate solutions, uranium or plutonium oxides; or uranium hexafluoride. (auth)

Disposal and Storage

Refer also to abstract 27284.

27933 ECONOMICS OF SPACE UTILIZATION. Woodcock, G. R. (Boeing Co., Seattle). Raumfahrtforschung; 17: No. 3, 135-146(1973).

NASA-studies are presented which, proceeding from the development of the U. S. space shuttle, refer to a maximum benefit of space utilization for minimum cost. Among others, the concept of a nuclear waste disposal system is reported for which a rough cost analysis is made. (GE)

27934 MANAGEMENT OF RADIOACTIVE WASTES. pp 299-315 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

General implications of radioactive waste disposal are discussed, in particular an attempt is made to appraise the total magnitude of the waste disposal problem now and in the future. Topics discussed include low-level waste management; management of high-level wastes (storage in tanks or in the ground, solidification, and waste disposal by hydraulic fracturing), and special problems of tritium and ^{85}Kr disposal. (DHM)

27935 DESIGN OBJECTIVES FOR HIGHLY RADIOACTIVE MATERIAL HANDLING AND STORAGE FACILITIES IN A REPROCESSING PLANT. New York; American Institute of Chemical Engineers (1973). 57p. (ANSI-N-305-1972). American National Standards Institute, Inc., New York.

A standard is presented that sets forth design objectives related to facilities for the handling and storage of highly radioactive materials in solid form. Within the scope of these design objectives are the following: (1) nuclear related safety; (2) dry or wet handling and storage; and (3) handling and storage of irradiated nuclear fuel, solidified radioactive waste or other like materials. The standard presents minimum design objectives of facilities for the handling and storage of spent fuel. It contains requirements for the design of the spent fuel storage pool including spent

fuel storage racks, pool makeup and cleanup systems, pool structure and integrity, radiation shielding, residual heat removal and radiation monitoring systems; the cask loading area including requirements for handling and decontamination of the shipping casks; and the containment building including requirements for ventilation, containment and fire protection. (auth)

Handling Equipment and Procedures

Refer also to abstract 27995.

27936 APPARATUS FOR REMOTE CONTROL AT LARGE DISTANCES. Vertut, J.; Guilbaud, J. P. (to Commissariat a l'Energia Atomique). French Patent 2,150,635. 3 Sep 1971. 38p. (In French).

A master-slave type remote control apparatus is presented in which the joining part can, in theory, be made to any length. The distance between the master and slave parts, which can be varied at will, makes the equipment suitable for operations inside nuclear reactor vessels. The access to the vessel is acquired by a vertical or sensibly vertical axis channel which crosses the slab or upper part of the vessel instead of a horizontal passage. (FR)

Transportation

27937 (RDT-E-12-4-T(8-73)) SHIELDED SHIPPING CASK FOR SPENT REACTOR FUEL ELEMENTS. (Division of Reactor Research and Development (AEC), Washington, D.C.). Aug 1973. 36p. RSO.

A standard is presented which delineates the requirements for the design, fabrication, testing, and inspection of a shielded cask for shipping irradiated reactor fuel elements. The standard is applicable to casks which utilize lead, uranium, and steel or other ferrous material for gamma shielding. The standard is applicable to casks transported by highway vehicle and by rail. (LCL)

27938 SHIPPING AND STORAGE CONTAINER FOR HIGH POWER DENSITY RADIOACTIVE MATERIALS. Leebl, R. G.; Sandvig, R. L.; Vejvoda, E. (to United States Atomic Energy Commission). U. S. Patent 3,754,141. 21 Aug 1973. Filed date 12 Jul 1972. 6p.

A shipping and storage container is described for radioactive material, particularly high thermal producing fissile material. The container consists of a cylindrical inner metal container for retaining the radioactive material, an alpha contamination barrier of polyvinyl chloride surrounding the inner container, a cylindrical outer metal container enclosing the inner container and barrier with inner surfaces spaced from the inner container walls and from the barrier, and finely divided heat absorbing and transferring or conducting magnesium oxide filling the space between the barrier and the inner surfaces of the outer metal container. (Official Gazette)

27939 MISCELLANEOUS SOURCES OF EXPOSURE TO RADIOACTIVE SUBSTANCES. pp 272-289 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The topics discussed are divided into three categories: radioactive substances that occur naturally, such as uranium, thorium, and radium; the fission by-products and transuranic nuclides (medical uses and radionuclides as sources of power); and transportation of radioactive substances. (DHM)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 28298.

27940 (AD-760344) BLACKJACK II PROPAGATION AND MERGING OF HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS. Final Report. Kolb, A. C.; Dobbie, C. B.; Miller, A. R. (Maxwell Labs., Inc., San Diego, Calif.). Apr 1973. Contract DASA01-70-C-0045. 100p. (MLR-140; DNA-2959-F). NTIS.

A facility with two low-impedance water dielectric coaxial pulse line electron accelerators has been constructed. The coaxial pulse lines are water filled and synchronized for operation to within plus or minus 2 ns. A beam transport system, with the capability of magnetic compression system, is used to drift and merge the two electron beams. High current density (j > 30 kA/cm squared) beams have been transported over distances of 1.3 m with transport efficiencies in excess of 80 percent. Compression ratio of 2 to 5:1 has been achieved, and current densities in the 50 to 100 kA/cm squared range are confirmed by carbon calorimeter and radiation measurements. (auth)

27941 (AED-CONF-71-400) CONFERENCE ON REPORT OF ELECTRON ACCELERATOR WORKING GROUP, GIESSEN, GERMANY, SEPTEMBER 23-25, 1971. Schneider, H. (ed.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (West Germany)). 1972. 510p. (In German and English). (CONF-710976-).

From conference on report of Electron Accelerator Working Group; Giessen, Federal Republic of Germany (23 Sep 1971).

Separate abstracts were prepared for 43 of the 44 papers presented. The remaining paper was previously abstracted as NSA as 28: 1338. (WHK)

For abstracts of individual papers see: 27095, 27442–27444, 27463, 27464, 27591, 27708, 27709, 27942–27944, 27950–27952, 27968–27970, 27983–27989, 28361, 28654, 28655, 28706, 28730, 28780, 28781, 28834, 28876, 28877, 28901–28906, 29080, and 29081.

27942 (AED-CONF-71-400, pp 85-108) WORK PROGRAM FOR THE LINEAR ELECTRON ACCELERATOR AT THE DEPARTMENT OF APPLIED NUCLEAR PHYSICS. Schneider, H. (Univ., Giessen, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The ongoing program has three major goals. The nuclear photo effect is studied with monoenergetic gamma quanta. Nuclear spectroscopic measurements are performed during the time interval between pulses of the linear electron accelerator. Nuclear spectroscopy is also applied to short-lived radionuclides. (HBG)

27943 (AED-CONF-71-400, pp 431-439) IMPROVEMENTS AND ADDITIONS TO THE LINEAR ACCELERATOR AT GIESSEN. Kneissl, U. (Univ., Giessen, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The linear accelerator at Giessen is described with respect to structure and performance. Several improvements of the installation, which are completed, are also reported. Additional refinements are under construction, especially an achromatic system which allows a 90° deflection of the beam. (HBG)

27944 (AED-CONF-71-400, pp 503-506) DEAD TIME CORRECTIONS IN LINAC OPERATIONS. Ahrens, J.; Ziegler, B. (Max-Planck-Institut fuer Chemie, Mainz). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Dead time losses occur in the numbers of events which are measured on generators emitting pulses that are variable with time. Two methods are described through which these losses can be connected. Dead time losses can be determined with an accuracy of approximately 5 percent at count rates up to 10^7 per second and at dead times of about 10 ns. (tr-auth)

27945 FEASIBILITY STUDIES OF LASER ACCELERATORS. Rossmanith, R. (Deutsches Elektronen-Synchrotron, Hamburg). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft: pulse physics, plasma physics, and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

It is shown that laser accelerators can be constructed both for relativistic and for non-relativistic particles. The advantages of these devices over previous rf accelerators are assumed to lie in the improved power density which is expected to make for savings of costs in accelerator construction. Chemical lasers seem to be particularly promising in this connection as they offer the possibility of directly accelerating the particles by means of laser beams and not via electrical energy. (GE)

27946 STUDY OF HEAVY ION BEAMS FROM A TANDEM GENERATOR. Freeman, J. M.; Hooton, B. W. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 111: No. 3, 501-507(1973).

The energy spectra of O, Al and Fe ion beams, accelerated in the Harwell tandem generator, have been studied with terminal voltages from 3 to 5 MV and carbon foil stripping. The measurements were made on the unanalysed, multiply-charged, and therefore multi-energy beams, by scattering from a thin Au foil into a Si detector; the corresponding charge-state distributions and average charges $\bar{q}$ were thus deduced. The results obtained for O ions are consistent with previous measurements of $\bar{q}$ for O beams emerging from a carbon foil at an energy equivalent to the terminal voltage; the results for Al and Fe ions may be slightly greater than the $\bar{q}$ values immediately after the stripper foil. The accelerated ion beams were found to be accompanied by a contaminant beam consisting of a few percent of singly charged O, N, C, H and some molecular ions, with energies up to that corresponding to the terminal voltage; these are attributed to ionization of the residual gas in the high energy accelerator tube. (auth)

27947 SACLAY ELECTRON LINEAR ACCELERATOR OF HIGH DUTY CYCLE AND HIGH BEAM CURRENT. Netter, F. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 179, 15-37(Mar 1973). (In French).

The 600 MeV electron linear accelerator is mainly characterized by a high-duty cycle of 1 to 2%. Accelerated beam currents with mean values of several hundreds of microamperes being available, special attention has to be paid to the potential destructive effects of high-intensity beams. Main solutions adopted to build the accelerator itself and the beam handling system are described, with emphasis on the method chosen for obtaining high stability and the possibility of fine adjustments. An average intensity of several tenths of a microampere is accessible for positron secondary beams accelerated to an energy of about 500 MeV. (FR)

27948 50 MeV BETATRON FOR PHYSICS RESEARCH. Prokopchuk, Yu. I.; Sedov, Yu. A.; Strizhak, V. I.; Aleksandrovskii, M. R.; Gel'perin, B. B. (Kiev State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 361-363(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 23-25(1973).

The principal structural features of the accelerator are described. The results of magnetic measurements are presented, and the startup of the betatron is described. The principal working characteristics are presented. The power of the absorbed dose of bremsstrahlung at a distance of 1 m from the betatron target is about 800 R/min. (auth)

27949 NEPTUNE HIGH-CURRENT PULSED RELATIVISTIC-ELECTRON ACCELERATOR. Kingsep, S. S.; Maksimov, G. P.; Sidorov, Yu. L.; Smirnov, V. P.; Spektor, A. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 364-366(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 26-28(1973).

A pulsed high-current electron accelerator having a beam current I = 10 to 30 kA and an electron energy E = 0.5 to 1 MeV is described. A pulse having a length of ~40 nsec was shaped by a Blümlein strip line in which distilled degassed water was used as the dielectric. The charging of the line was achieved by means of two standard GIN-400-0.06/5 pulse generators connected in series. (auth)

Auxiliaries and Components

Refer also to abstract 27444.

27950 (AED-CONF-71-400, pp 235-241) CALIBRATION OF ELECTRON ENERGY BY NEUTRON DETECTION. Herkommer, E.; Harder, D. (Univ., Wuerzburg, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The neutron yield of the reactions $^{63}Cu(e,e'n)^{62}Cu$ and $^{65}Cu(e,e'n)$ ^{64}Cu with the Wuerzburg 35-MeV betatron has been measured by means of a large-area BF_3 neutron detector as a function of the

electron energy. The two threshold energies at 10.855 and 9.906 MeV could be easily identified with high accuracy. The dependence of the response ability on the neutron energy has been determined by monoenergetic neutrons in the Frankfurt ion accelerator. (tr-auth)

27951 (AED-CONF-71-400, pp 279-287) EMPLOYMENT OF TURBO-MOLECULAR PUMPS IN ACCELERATOR SYSTEMS. Henning, J. (Pfeiffer (Arthur) Vacuumtechnik, Wetzlar, Ger.). 1972. (In German).

From conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The special properties of turbomolecular pumps are discussed which are especially suited to be applied in vacuum systems of accelerators. Besides a vacuum free of hydrocarbons, these pumps are distinguished by their operational simplicity and by a suction ability which is independent of the intake pressure. (GE)

27952 (AED-CONF-71-400, pp 459-462) INDUCTION MONITOR FOR THE CHARGE DETERMINATION OF SINGLE BEAM PULSES. Stephan, G. (Univ., Mainz). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Electron scattering experiments on rapidly changing targets require the charge determination of a single pulse. This task is accomplished through an induction monitor that is designed as a current transformer which measures the charge with 0.5 percent accuracy independently of the target for mean currents from 7.5 μA to 7.5 nA with a sequential frequency of 150 cycles per second. Over a wide range, the measuring accuracy is independent of both pulse form and pulse duration. (tr-auth)

27953 VACUUM PROBLEMS IN PARTICLE ACCELERATORS. Gonella, L. (Istituto Nazionale di Fisica Nucleare, Turin). Vuoto Sci. Technol.; 5: No. 2, 53-66(1972). (In Italian).

The quality of the vacuum system in a particle accelerator is not determined simply by the need of getting the air out of the particle path, but mainly by complex requirements relative to surface conditions, accessibility of the vacuum chamber, and operation reliability. These requirements are discussed in order to understand the difference between accelerator vacuum plants and those in industrial plants, and why the vacuum design should be deeply integrated into the system design of the machine is pointed out. (INIS)

27954 SHIELDING OF MUONS AROUND HIGH ENERGY ELECTRON ACCELERATORS: THEORY AND MEASUREMENT. Nelson, W. R. Stanford, CA; Stanford Univ. (1973). 236p. University Microfilms Order No. 73-20,503.

Thesis (Ph.D.).

The muon fluence and the absorbed dose that is produced when a high energy electron beam is completely attenuated in matter is calculated by integrating the muon pair production cross section over the photon distribution in the electromagnetic shower. Several cross section and photon track length formulae are examined. The Fermi-Eyges theory of multiple Coulomb scattering is applied to the case of 1 to 20 GeV muons penetrating thick shields, and the results are folded into the production theory. A measurement of the fluence and the absorbed dose caused by muons originating in an electron beam dump and penetrating a thick steel shield was performed at the Stanford Linear Accelerator Center. Detectors (nuclear track emulsions, plastic scintillation counters, and thermoluminescent dosimeters) were positioned lateral to the incident electron beam direction at various steel thicknesses ranging from 17 to 23 ft. The total electron charge that went into the dump-target was known to a few percent and the detectors were precision aligned. The results of the experiment are compared with the theoretical model and the following conclusions are reached: (1) the muon fluence and the absorbed dose in the zero degree direction are correctly predicted by the theoretical model. However, in the case of the absorbed dose, the theory must use a restricted stopping power in order to get the best results, (2) the theory gradually disagrees with the measurements as the detector angle increases. At the largest detector angle (about 150 milliradians), the measurements are 20 to 30 times higher than the theory (using a coherent production cross section). Integration under the respective curves gives a total experimental muon yield (i.e., muons/Coulomb) that is 32% higher than the yield predicted by the coherent theory, (3) contributions from elastic interactions with nucleons (i.e., the elastic incoherent term) do not seem to explain the discrepancy. Nor does the inelastic component. Furthermore, the increase in the fluence at wide angles can not be understood by any approximations made in the model, (4) angular distribution measurements suggest that most of the muons at the wide angles get there more or less directly from the dump-target, suggesting that the source is not as calculated, (5) inserting a one radiation length beryllium target just in front of the dump causes the muon fluence to increase by a factor of four at the widest detector position, but no change is indicated in the zero degree direction, (6) calculations of the yield of muons from the decay of pions and/or kaons, before they can interact, are made. They do not explain the discrepancy either, and (7) a constant background component is observed in the dose measurements, but it is not seen in the fluence data. The source is believed to be photons that originate in the dump and scatter over the top of the wall through relatively thin shielding. (Diss. Abstr. Int. B)

27955 MODIFIED DESIGN OF A MICROTRON MAGNET AND ITS ENERGY-ERROR-FREE ORBITS. Bhiday, M. R.; Bhoraskar, V. N.; Bhalla, R. K.; Asgekar, V. B. (Univ. of Poona, India). pp 495-499 of Proceedings of the Nuclear Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27956 ENERGY CALIBRATION OF A 2-MeV VAN DE GRAAFF ACCELERATOR. Garnir, H. P.; Weber, G.; Winand, L. (Univ., Leige). Nucl. Instrum. Methods; 111: No. 3, 549-554(1973). (In French).

The deuteron calibration of a 2-MeV Van de Graaff accelerator has been achieved by means of Rutherford scattering of charged particles. The aim of this work is to supply the users a fast, easy and precise calibration method in the energy range where nuclear reactions methods fail. Some considerations on the choice of the target and the determination of the maximum diffusion energy are developed. (auth)

27957 ON-DEMAND BEAM PULSING FOR AN ACCELERATOR. Thibeau, H.; Stadel, J.; Cline, W.; Cahill, T. A. (Croker Nuclear Lab., Davis, CA). Nucl. Instrum. Methods; 111: No. 3, 615-617 (1973).

A method for effectively pulsing the cyclotron beam impinging on an external target by sweeping it out of a slit collimator system in less than 0.5 μs is described. (auth)

27958 SEMIAUTOMATIC SYSTEM FOR MEASURING THE INDUCTION OF AN ISOCHRONOUS CYCLOTRON'S MAGNETIC FIELD. Arzumanov, A. A.; Batalin, S. S.; Volkov, B. A.; Nemenov, L. M.; Sanachev, V. I.; Spinko, N. V.; Tkachuk, V. M. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 2, 237-239(Feb 1973).

Translated from Izmer. Tekh.; 16: No. 2, 50-51(Feb 1973).

A magnetometer using a Hall transducer for measuring the magnetic field in an isochronous cyclotron is described. The optical-electronic system, the Hall transducer, and the power amplifier are discussed. (WHK)

27959 SECONDARY-EMISSION MONITOR BASED ON DELTA-ELECTRONS. Gol'dshtein, V. A.; Arkatov, I. M.; Startsev, V. I. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 391-392(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 50-51(1973).

The construction of a secondary-emission monitor that operates on δ electrons is described, and the results of an experimental check of the monitor are presented. The dependence of the yield of δ electrons from the spot of incidence on the intensity and energy of the primary beam that passes through the monitor was measured. The stability of the yield of δ electrons from the instrument was at worst ±0.5% for an output magnitude equal to (2.634 ± 0.013)%. (auth)

27960 MEASUREMENT OF THE CURRENT AND SHAPE OF ELECTRON BEAM PULSES. Borodulin, A. I.; Emel'yanov, V. K.; Nikolaev, N. A.; Rytin, V. M.; Shestak, V. P.; Tsyplyakov, A. P. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 388-390(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 47-49(1973).

Two transistor-amplifier circuits are proposed for operation with magnetoinductive transducers. The range of measured pulse currents is 10 μ A to 500 mA. The error in measuring the amplitude is <4%. The fall-off of the flat top is <3% μsec. The transmission factors for the first circuit is 165 V/A, while for the second it is 10^4 V/A. Oscillograms obtained of the pulse current by means of these circuits are presented. (auth)

27961 PIEZOACOUSTIC PICKUPS FOR MEASUREMENT OF THE PARAMETERS OF CHARGED PARTICLES. Armenskii, E. V.; Emel'yanov, V. K.; Rybin, V. M.; Nikolaev, N. A.; Tokarev, A. I. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 385-387(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 44-47(1973).

Pickups are considered whose principle of operation is based on the effect of the excitation of elastic vibrations in a metal by charged particles that pass through it. The current density distri-

bution and the dependence of the conversion coefficient on particle energy which are obtained experimentally using such pickups are presented. A circuit for automatic handling of the signal from the acoustic pickups is proposed. (auth)

27962 DISPLAY OF CURRENT MICROPULSES AT VARIOUS RADII OF A CYCLOTRON. Dvornikov, V. D.; Rezvov, V. A.; Yudin, L. I. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 381-384(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 41-44(1973).

A device is described for measuring the phase, the time structure, and intensity of microbunches of ions at several radii of the two-dee cyclotron at the Atomic Energy Institute. The instrument allows measurements to be carried out in the working frequency range of the cyclotron without interrupting the current. The schematics of the device are given along with the results of experimental investigations. (auth)

27963 OBTAINING SHORT PULSES OF ION CURRENT ON A VAN DE GRAAFF ACCELERATOR. Kononov, V. N.; Metlev, A. A.; Poletaev, E. D.; Volodin, V. I.; Kanaki, V. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 367-369(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 29-31(1973).

A device is described for realizing a pulsed operating mode of a Van de Graaff accelerator. The length of the pulses of ion current can be varied from 5 to 500 nsec for an independent variation of the pulse repetition frequency from 0 to 800 kHz. The electrical power drawn by the device is 70 W. A generator producing short rectangular pulses with an amplitude of up to 1.8 kV and a high repetition frequency is used. (auth)

Ion Sources and Injection and Extraction Systems

27964 PROCESS FOR THE EXTRACTION OF A CYCLOTRON CHARGED PARTICLE BEAM. Boettger, O.; Mahrt, R. (to Licentia Patent Verwaltungs GmbH). German Patent 1,815,748. 16 Jul 1970. Filed date 19 Dec 1968. (In German).

A process for the extraction of a charged particle beam from a cyclotron characterized by the fact that two interfering fields are arranged in two opposing azimuthal regions starting with a definite beam is described. These two interferences of different sign cause at each rotation a sufficient separation and their radial gradients of rise are conceived in such a fashion that the paths meet along their passage in interfering regions of gradients of comparable values of different signs and that the electric deflector is disposed at the azimuth in which the separation of path from the last rotation produces the greatest variation. (TSS)

27965 OPERATIONAL CHARACTERISTICS OF AN ELECTROSTATIC CHARGED-PARTICLE OSCILLATOR ION SOURCE. Mukherjee, D. K.; Bhattacherya, R. S. (Saha Inst. of Nuclear Physics, Calcutta). pp 471-475 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27966 NEGATIVE-ION INJECTOR OF AN ELECTROSTATIC CHARGE-EXCHANGE ACCELERATOR. Golubev, V. T.; Komarov, V. L.; Nalivaiko, G. A.; Tokarev, G. M.; Tsepakin, S. G. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 370-372 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 32-33(1973).

A negative-ion injector of an electrostatic charge-exchange accelerator is described along with its special features and principal characteristics. A beam of negative hydrogen ions with a current of 70 μA and an energy of 25 to 60 keV was obtained at the output of an injector having an ion source of the duoplasmatron type during bench tests. An ion beam having an energy of 10 MeV and an intensity of 12 μA was obtained at the accelerator output. (auth)

27967 PROTON-ELECTRON INJECTOR (PEI-30). Markin, P. S.; Tsygikalo, A. A.; Sanin, F. P.; Anpilogov, E. I. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 376-377(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 37-38(1973).

A proton (p^+) and an electron (e^-) injector is described having a controllable energy of 2 to 30 keV and a controllable intensity of the p^+ or e^- current ranging from 2 to 50 μA. The source allows separate particle beams and beams combined in one to be obtained, and also allows the beam to be scattered on a target having an area of 100 cm^2. (auth)

Ion Optics and Field Calculations

27968 (AED-CONF-71-400, pp 443-448) FORMULAS FOR THE CALCULATION OF PULSED BEAM GUIDANCE MAGNETS WITH CYLINDRICAL WINDING. Huettl, W.; Harder, D.; Roos, H. (Univ., Wuerzburg, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

For the arrangement of axial parallel currents on the surface of a circular cylinder and for a vanishing sum of currents, a simple relationship exists between the generated magnetic field and the angular current density. The relationship permits the calculation of the current distribution for any fields in the interior of the cylinder which are free of eddies and sources. A simple rule also applies for the approximation through arranging discrete windings on the cylinder surface. (tr-auth)

27969 (AED-CONF-71-400, pp 463-472) SENSITIVE INDUCTION MONITOR FOR THE MEASUREMENT OF VERY SMALL, PULSED POSITRON CURRENTS. Weller, A. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

To obtain a good signal-noise ratio at small positron currents, the generation of damped oscillations in a resonating circuit is most suitable. The parallel-resonant circuit consists of a toroid-shaped ferrite coil with the positron beam as the primary winding. The amplifier, exit signal, and current integrator are described. With an accuracy of one percent, the monitor measures pulse currents as low as 0.05 μA and current integrals at pulse currents as low as 0.01 μA. (HBG)

27970 (AED-CONF-71-400, pp 473-479) EXACT DETERMINATION OF THE CHARGE LOSS OF A FARADAY COLLECTOR BY MEANS OF A BEAM CURRENT TRANSFORMER. Feist, H.; Koep, M. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Through the combination of two known methods, the charge of a Faraday collector is determined with an error smaller than 0.1 percent. The procedure can be applied to scattering measurements, the determination of beam profiles, and the measurement of extremely small beam currents. (tr-auth)

27971 (BNL-18201) RANDOM ERROR MULTIPOLES IN SUPERCONDUCTING WINDOW-FRAME MAGNETS. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 20 Aug 1973. 8p. Dep. NTIS $3.00.

The random error multipoles in the magnetic field of a window-frame magnet due to random errors in the position of the current blocks are computed. The computed random error multipoles in cosine and window-frame magnets are compared. The results of measured results for the random error multipoles in a superconducting window-frame magnet are compared with the computed results. (auth)

27972 (IFVE-INZ-72-24) DIGITAL SIMULATION OF PARTICLE DYNAMICS IN THE INITIAL PART OF THE ACCELERATOR WITH RF QUADRUPOLE FOCUSING. Konoplev, E. A.; Mal'tsev, A. P.; Stepanov, V. B. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 21p. (In Russian). INIS.

The results of the digital simulation of the beam dynamics in the initial part of the accelerator with rf quadrupole focusing are discussed. The calculated spectrum, emittance, distribution of the particle density along the bunch, and acceptance of the channel for different inlet phases are reported. (tr-auth)

27973 PARAXIAL ELECTRON-OPTICAL IMAGE IN A QUADRUPOLE SYSTEM ON A WAVE-MECHANICAL BASIS. Storbeck, F. (Technische Universitaet, Dresden). Ann. Phys. (Leipzig); 29: No. 1, 63-74(1973). (In German).

How the intensity distribution in any arbitrary plane may be found from the wave function in the object plane on the basis of paraxial and wave mechanical approximation for a system of electrostatic round lenses and electrostatic and magnetic quadrupoles was investigated. The paraxial wave mechanical imaging in electrostatic cylindrical lenses and in exact quadrupole lenses are given as special cases. (auth)

27974 ELECTROSTATIC LENS FOR MONOCHROMATIC ELECTRON BEAMS. Mezentsev, A. P.; Kadyrova, V. S.; Senyushkin, V. B.; Fedorov, V. L. (Leningrad Mining Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 9, 1558-1559 (Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1944-1946(Sep 1972).

The possibility of using the chromatic aberration of an electrostatic lens to produce a monochromatic electron beam was examined. All the calculations are for paraxial electrons, neglecting space charge. The graphical dependence of the weight functions on the geometric parameters of the lens is obtained. These functions can be used to evaluate the quality of the electron beam. In a case of some practical interest, with an electrostatic lens with a focal length of 1 cm, radius of the entrance and exit diaphragm 10^{-3} cm, angular aperture of the electron beam 0.1, magnification 1:1, and initial electron energy 2 eV, it is possible to obtain an electron energy distribution with a half-width of 0.03 eV. An advantage of the described element is the comparative simplicity of construction. (auth)

27975 STUDIES ON AN N = 8, E = $\frac{1}{2}mc^2$ SPIRAL-SECTORED CYCLOTRON. Jain, A.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 477-481 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27976 DOUBLE FOCUSING IN AN INHOMOGENEOUS MAGNETIC DIPOLE WITH FRINGING FIELD. Bhattacharya, N. C.; Neogy, P.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 483-488 of Proceedings of the Nuclear Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27977 CORRECTION OF EFFECTS OF QUADRUPOLE MAGNET MULTIPOLARITIES ON BEAM PHASE-SPACE ELLIPSES. Sethi, R. C.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 489-494 of Proceedings of the Nuclear Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

27978 CALCULATIONS AND MEASUREMENTS FOR A MAGNETIC QUADRUPOLE LENS WITH A LARGE APERTURE AND A BELL SHAPED FIELD DISTRIBUTION. Schott, W.; Springer, K.; Winter, H. J.; Daniel, H. (Univ., Munich). Nucl. Instrum. Methods; 111: No. 3, 541-547(1973).

A magnetic quadrupole lens of an aperture radius of 12.5 cm and a physical over-all length of 12 cm is described. The fringe field is linearized by means of rounded-off pole pieces and parallel end plates. The distribution of the transverse field components along the axis is nearly bell-shaped. The field strength necessary to focus parallel incoming electrons of an energy of 20 keV has been measured. The effect of the field distribution on the motion of electrons through the quadrupole lens has been calculated in first order theory using a hard-edge and a bell-shaped model. The bell-shaped model gives 4 and 3% larger fields than the hard-edge model, respectively, for two different focal lengths. There is a good agreement between measurement and bell-shaped model calculations for paraxial rays. For beams crossing the axis at large angles the fringe field linearization reduces the third order aberration by a factor of 4 compared to a pure bell-shaped quadrupole field. Moreover, the focusing fields were obtained by a stepwise numerical integration of the trajectory equations using the measured field distribution. The agreement with the measurements is satisfactory. Finally the stigmatic focusing of parallel beams by a quadrupole doublet consisting of two of these lenses has been considered. The bell-shaped model yields better results than the hard-edge model as is shown by numerically calculated trajectories using the measured field distributions and the field gradients obtained by the models. (auth)

27979 APPROXIMATE CALCULATION OF A TRIPLET OF QUADRUPOLE LENSES. Alkhazov, G. D. (Leningrad Inst. of Nuclear Physics). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 393-395(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 52-53(1973).

The approximation based on semi-thin lenses is used to derive formulas for the gradient in the triplet which yields a stigmatic image. Three cases are considered: (1) when the gradient in one of the extreme lenses is stipulated; (2) when the gradient in the central lens is stipulated, and (3) when the ratio between the gradients of the extreme lenses is stipulated. The error in determining the gradient according to the proposed formulas amounts to $\sim(l/f)^2 \cdot 1\%$ for $l/f \leq 1$, where l is the effective length of the lens and f is the focal distance. (auth)

Storage Rings

27980 (RL-73-52) GOOD FIELD REQUIREMENTS IN THE ELECTRON RING OF EPIC II/II. Maidment, J. R. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

EPIC lattice studies have now reached the stage where the apertures required in both the conventional magnet electron storage ring (ESR) and the superconducting magnet proton ring (PR) may be specified. This note details the apertures for the electron ring and lists all the assumptions upon which they are based. (UK)

27981 POLARIZATION KINETICS OF PARTICLES IN STORAGE RINGS. Derbenev, Ya. S.; Kondratenko, A. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 6, 1918-1929(Jun 1973). (In Russian).

A description of the radiative kinetics of the polarization of charged particles with arbitrary spin and magnetic moment is presented which takes into account spin-orbit coupling. The analysis is based on an investigation of the dynamics of spin motion in inhomogeneous fields. For ultrarelativistic electrons (positrons) the results of a number of investigations are combined, and some new effects due to spin-orbit coupling in an inhomogeneous field are discussed. The time constant and degree of equilibrium polarization of a beam in storage rings with arbitrary fields are found for nonresonant conditions. The method developed may also be applied for nonresonant conditions. The method developed may also be applied when the perturbing electromagnetic field is related to an external source. (auth)

27982 WAVELENGTH SHIFTER FOR THE UNIVERSITY OF WISCONSIN ELECTRON STORAGE RING. Trzeciak, W. S. Madison, WI; Univ. of Wisconsin (1973). 162p. University Microfilms Order No. 73-15,995.

Thesis (Ph. D.).

A "wavelength shifter" is being constructed for the University of Wisconsin electron storage ring. The wavelength shifter consists of an H-type magnet with three gaps mounted on a base and designed so as to replace one of the storage ring long straight sections. In operation, the wavelength shifter will cause a radially outward "bump" in the equilibrium orbit. In the central gap the electrons will pass through a 24.5kG field. This high field region will cause the accelerated electrons to emit more photons of higher energy, compared to the spectrum from one of the storage ring bending magnets. Theoretical calculations are done to insure that the wavelength shifter does not adversely affect the normal storage ring operation. The Courant and Snyder formalism is used to calculate tune shifts and stopband widths by considering the wavelength shifter as a straight section perturbation. Changes to the synchrotron radiation damping rates are also calculated. For an optimum wavelength shifter design, the magnet poles should be wedge shaped for normal entry and exit of the orbiting electrons and each of the three magnetic field regions should have a field index of $\frac{1}{2}$. The tune shifts from such an optimum design are calculated to be $\Delta\nu_x = 0.028$ and $\Delta\nu_z = 0.024$. Stopband widths at nearby resonances are ≤ 0.057. The maximum change to the radiation damping rates is $\leq 10\%$. The magnet has been built and tested. Small adjustments in the geometry have been made to make the magnet acceptable. The net steering error has been corrected to within the limitations of the field measurement system, 1% of the maximum shifter deflection angle. The field indices have been corrected to yield calculated tune shifts of $\Delta\nu_x = 0.012$ and $\Delta\nu_z = 0.054$, still acceptable. The magnet pole and coil design, field measurement techniques, and mechanical engineering design problems are also discussed. (Diss. Abstr. Int. B)

Experimental Facilities

Refer also to abstracts 27479 and 28654.

27983 (AED-CONF-71-400, pp 135-145) FIXED-ANGLE SPECTROMETER AS MONITOR OF THE PRODUCT CHARGE TIMES TARGET THICKNESS FOR ELECTRON SCATTERING MEASUREMENTS. Stolz, H. M. (Univ., Mainz). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

A magnetic spectrometer installed at the 300-MeV electron linac at a scattering angle of 28° allows the measurement of the product charge times target thickness. Thus, it is possible to measure relative and absolute target thicknesses and to perform electron scattering studies also on inhomogeneous targets. Rare isotopes can be studied as well. (tr-auth)

27984 (AED-CONF-71-400, pp 391-399) MEASUREMENT OF HIGH ENERGY NEUTRONS FROM (e,n) AND (γ,n) REACTIONS THROUGH THE FLIGHT TIME METHOD (GENERATION OF NSEC LINAC PULSES). von Eyss, H. J.; Schier, H.; Schoch, B. (Univ., Mainz). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Electron pulses of 6 nsec were generated with the linear accelerator. After a flight of 24.6 m, the electrons hit a thick target which emitted neutrons at a 90° angle. The neutrons were detected with a plastic scintillator and photomultiplier. For primary electron energies of 150 MeV to 266 MeV, the differential cross sections for neutron generation were determined on thick targets of C, Al, Cu, Cd, and Pb. The experimental findings could be described well by the quasi deuteron model. At electron energies above 200 MeV and with thin targets, deviations from the model became significant. (HBG)

27985 (AED-CONF-71-400, pp 401-411) CALIBRATION MEASUREMENTS ON THE MONO-ENERGETIC GAMMA BEAM. Kneissl, U.; Koop, E. A.; Kuhl, G.; Moster, C.; Schneider, H.; Weller, A. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

A status report is presented on the monoenergetic gamma source with variable energy which is located at the Giessen electron linac. The gamma flux is calibrated by means of the positron current and is compared with results of computations. Difficulties of this calibration method are discussed. (tr-auth)

27986 (AED-CONF-71-400, pp 415-420) PHOTONUCLEAR REACTION FACILITY AT THE GHENT-STATE-UNIVERSITY LINAC. Van de Vijver, R.; Ferdinande, H.; Knuyt, G.; Carchon, R. (Rijksuniversiteit, Ghent). 1972.

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Operating parameters of the Ghent State Univ. electron linac are given, and the bremsstrahlung facility is described. The electron-photon converter is a gold foil of 180 mg/cm^2. Results of $^{12}C(\gamma,xn)$ cross sections are given. (WHK)

27987 (AED-CONF-71-400, pp 421-428) GAMMA SPECTROSCOPY IN A PULSED BREMSSTRAHLUNG. Bartsch, H.; Huber, K.; Schneider, H.; Voelpel, R.; Woelcken, K.; Wunderling, P. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

Using a γ-spectrometer, measurements in the pulsed bremsstrahlung at the Giessen electron linac have been performed. Among others, a dc-coupled Ge (Li)-detector and a modified preamplifier (overload recovery circuit) have been used. With an improvement of this circuit, a deadtime of 16 μsec has been obtained. The operation of the system is shown for test measurements on the shortlived ^{77}As and ^{101}Ru isomers. (INIS)

27988 (AED-CONF-71-400, pp 481-490) DATA EVALUATION FOR THE LINEAR ACCELERATOR AT GIESSEN. Huber, K.; Sattler, G.; Sattler, H.; Woelcken, K.; Wunderling, P. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

The radiation center possesses a TR 86 data evaluation facility. The facility stores the results of experimental findings, especially the gamma spectra coming from multichannel analyzers. The facility also evaluates spectra, evaluates nuclear spectra through fit programs, and computes and corrects both magnetic and electrostatic beam guidance systems. Hardware, software, and fit program are described. (HBG)

27989 (AED-CONF-71-400, pp 493-501) FAST RABBIT TUBE FOR BREMSSTRAHLUNG ACTIVATION. Berg, U.; Engel, H.; Gerst, E.; Schneider, H. (Univ., Giessen, Ger.). 1972. (In German).

From Conference on report of Electron Accelerator Working Group; Giessen, Germany (23 Sep 1971).

A fast rabbit tube was constructed at the Giessen electron linac which permits the simultaneous activation of one sample via the photonuclear effect by bremsstrahlung and to measure a second one. The transport time from the irradiation place to the measurement place is well below one second. With this arrangement the energy of the first excited level of ^{31}P has been determined to be 1226.5 ± 0.5 MeV. (INIS)

27990 (KFK-1817) INVESTIGATIONS ON MULTIPERIODIC STRUCTURES AND ON THE FREQUENCY TUNING OF UNIFORM PERIODIC STRUCTURES FOR SUPERCONDUCTING SEPARATORS. Dammertz, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Feb 1973. 82p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

The deflecting fields in superconducting separator structures are limited, up to now by the magnetic surface fields. In order to reach high deflecting fields, multiperiodic structures are preferable, because they allow a favorable ratio of H_p/E_0. A theory which is an extension of the theory of the uniform periodic iris loaded deflector and which allows the calculation of the dipole fields in any periodic or non periodic resonators is described. With this theory the geometry of a few multiperiodic structures was calculated, especially the ones which lead to confluence in the dispersion diagram at the wanted frequency. The powering of two resonators by one generator requires that the frequencies of the two resonators correspond within one bandwidth. For the coarse tuning as well as for the regulating, mechanically driven, superconducting tuners are chosen. The layout, the parameters of the system, and test measurements are described. (auth)

27991 (LA-5348-MS) HEATING OF TARGET CELL COMPONENTS BY SECONDARY PARTICLES PRODUCED BY THE LAMPF PROTON BEAM. Thompson, P. A. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 15p. Dep. NTIS 4.00.

The 1 mA 800-MeV proton beam at LAMPF contains 800 kW of energy. Calculations have been made of the amount of heat produced by the absorption of secondary particles in some of the magnets in Target Cell No. A-2. For thick targets the total energy released in this target cell is of the order of 500 kW and the amount absorbed by each of the three magnets considered of the order of 100 kW. These numbers are sufficiently large that they must be carefully considered and appropriate cooling supplied. The recommendation of this note is to shield the magnets as much as practical and to provide water cooling for the yoke of the magnets. It is also recommended that the thickest target to be considered for use in Target Cell No. A-2 under 1 mA beam conditions be 6 cm of Al_2O_3 (which is referred to as the "standard maximum target"). The gain by going to thicker targets is probably not worth the added cost in terms of cooling capacities. The results developed are mainly devoted to Target Cell No. A-2; however, a few cases have been run for the biomedical channel and the muon channel results can be scaled for the biomedical beam line. Target Cell No. A-1 has similar problems which are not the biomedical beam line. Target Cell No. A-1 has similar problems which are not considered herein. (auth)

27992 (LBL-1912) TEMPERATURE OF THIN FOILS IN ION BEAMS. Liljenzin, J. O. (California Univ., Berkeley. Lawrence Berkeley Lab). Jun 1973. Contract W-7405-eng-48. 60p. Dep. NTIS $5.45.

The effect of beam-shape, pulsed operation and ion type on the temperature of thin foils in ion beams is discussed for cases where the cooling is by heat radiation, heat conductions, or convection in an external medium. Analytic solutions are given for various combinations of beam shape and cooling conditions. Nomographs are given for the estimation of the maximum temperature of thin circular foils when the cooling is either by radiation to the surroundings or by conduction to the edge of the foil. A program is described which can be used to calculate the temperature distribution at equilibrium conditions or as a function of time for arbitrarily shaped non-isotropic and non-homogeneous bodies heated internally and cooled by any combination of radiation, conduction, or convection of heat in an external gaseous medium. The heat conductivity, heat capacity, heat generation, and grayness can vary within the body; the heat conductivity and heat capacity can vary with temperature; and the heat-generation can be pulsed. Cooling by a liquid streaming on the backside of the foil is generally most effective. Radiative cooling is also dominant for very thin foils, and conduction cooling is dominant for thick foils. At a given diameter, this leads to a maximum temperature for foils with a thickness a little below the range of the ions. (auth)

27993 VELOCITY SEPARATION OF BEAM AND REACTION PRODUCTS BEHIND THE TARGET OF A HEAVY ION ACCELERATOR. Ewald, H.; Hinckel, P.; Muenzenberg, G.; Nickel, F.; Guettner, K.; Wollnik, H. (Univ., Giessen, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

Three versions of focusing the velocity filter are described for beam analysis behind the target. Version 1 consists of two Wien filters with symmetrically ordered fields and an achromatic focusing system composed of four homogeneous magnetic fields. Version 2 has instead of the Wien filter, a deviation condenser near the target which is operated at 500 kV. In the third version, two symmetrically ordered quadrupole doublets are used as focusing elements. The advantages and disadvantages of these three concepts are discussed. (GE)

27994 DESORPTION OF TRITIUM FROM TARGET SOURCES. Iyengar, T. S.; Soman, S. D.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). pp 764-772 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV: Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

Studies on tritium release from used and fresh titanium–tritium targets for neutron generators are discussed for targets under three conditions: dynamic equilibrium of the target with its surroundings, constant leakage under different flow rates of carrier gas, and tritium loss at high temperatures. (WHK)

27995 CONTAINMENT OF ELEMENTAL TRITIUM AND TRITIATED WATER. Clack, R. W.; Lambert, J. P.; Echkoff, N. D. (Kansas State Univ., Manhattan). pp 772-775 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The setup and results of an experiment to study tritium containment by polyethylene are described. The study was particularly directed toward accelerator target storage. It is concluded that a plastic cover provides significant containment of tritium that would otherwise be released to the surrounding atmosphere. (WHK)

27996 EXPERIENCE IN RECONDITIONING ION PUMPS CONTAMINATED BY TRITIUM DURING NEUTRON GENERATOR USE. Beeman, W. T.; Wessman, R. A.; Leventhal, L. (TRAPELO/WEST, Richmond, CA). pp 793-801 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A reconditioning procedure for removing the tritium contamination from ion pumps in neutron generators using tritium targets is described. The pump interior is cleaned, loose tritium-contaminated particles are removed, and the gettering elements are replaced. Tritium levels measured in different contaminated pumps are cited. (WHK)

27997 FEATURES OF A HIGH RESOLVING MAGNETIC SPECTROMETER AT GSI. Puehlhofer, F. (Univ., Marburg, Ger.). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

The reasons for the proposal to build a high resolving magnetic spectrometer on Unilac are given and the apparatus is described. The field of application of such a spectrometer is the analysis and identification of reaction products of heavy ion induced nuclear reactions, especially with high energy resolution and in general under 0° various reaction angles. (GE)

27998 BEAM ANALYZER AND TIME-OF-FLIGHT SPECTROMETER FOR REACTION PRODUCTS IN BEAM DIRECTION AT THE UNILAC. Huenges, E.; Vonach, H. (Technische Univ., Munich). (1973). vp. (In German).

From GSI working conference on particle spectrometers; Darmstadt, Germany (8 Jan 1973).

A beam analyzer system is proposed to enable the observation of compound nuclei which occur in heavy ion reactions with targets of about the same mass number and are emitted in the direction of the primary beam. (GE)

27999 BOMBARDON. An Apparatus for Investigating the Influence of 5 to 20 keV Ions on Metal Targets. Eckstein, W.; Verbeek, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Vacuum; 23: No. 5, 159-162(May 1973).

An apparatus for ion bombardment in the energy range of 5 to 20 keV is described. The ion beam, produced by a duoplasmatron ion source, is purified by a magnetic sector field and directed into a target chamber 60 cm in diameter. The chamber is evacuated by sputter ion and titanium sublimation pumps with a total pumping speed of 20,000 $1s^{-1}$ for H_2. The energy and angular distributions of particles backscattered from metal targets can be measured with an electrostatic spherical condenser which can be pivoted around the target. The whole apparatus is bakeable up to 250°C. With a 100 μA proton beam a pressure of 10^{-9} torr is maintained in the target chamber. The blank off pressure is a few 10^{-11} torr. (auth)

28000 REALIZATION OF MONOKINETIC NEUTRON BEAM WITH MAXIMUM MOMENTUM 1.9 GeV/c, USING THE DEUTERONS OF THE SYNCHROTRON SATURNE (SACLAY). Bizard, G. (Univ. of Caen, France); Bonthonneau, F.; Laville, J. L.; Lefebvres, F.; Malherbe, J. C.; Regimbart, R.; Duflo, J.; Plouin F. Nucl. Instrum. Methods; 111: No. 3, 451-459(1973).

The general properties of a monokinetic neutron beam, obtained by breaking high-energy deuterons, are studied; and the characteristic features of the Saclay neutron beam produced through this method are described. (auth)

28001 TRANSPORT EFFICIENCY OF THE HELIUM-JET RECOIL TRANSPORT METHOD WITH PURE HELIUM. Aeystoe, J.; Valli, K. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 111: No. 3, 531-537(1973).

New techniques have been developed for measuring the transport efficiency of the helium-jet recoil-transport method in the transport of radioactive recoil atoms. The dependence of the transport efficiency on main equipment parameters was studied experimentally using pure commercial-grade helium. The results are given in terms of helium mass throughput, capillary parameters and location of a catcher foil. High to moderate efficiencies were observed at transport distances shorter than 20 cm. Efficiencies obtained with pure helium at distances longer than 1 m are low, typically less than 1%. Possibilities for further development of the method are briefly discussed. (auth)

28002 SIMPLE METHOD FOR FILTERING PUMP FLUID VAPORS FROM CIRCULATED HELIUM. Hillebrand, S.; Puumalainen, P.; Valli, K. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 111: No. 3, 539-540(1973).

A simple efficient ceramic filter has been introduced for separation of oil vapors from circulated helium. Oil vapors were observed to pass easily through standard cold-trap and zeolite filters. They behave in these filters in the same way as "carrier fragments" behave in the helium-jet recoil-transport method. The significance of this observation is discussed. (auth)

28003 SELF-SUPPORTING TARGETS OF ISOTOPIC ^{11}B AND ^{13}C. Woodburn, E. H.; Kundu, S.; Del Bianco, W. (Univ. of Montreal). Nucl. Instrum. Methods; 111: No. 3, 611(1973).

A method for the preparation of self-supporting ^{11}B and ^{13}C targets is described. It makes use of a colloidal suspension in isopropyl alcohol of either isotope and yields films with thicknesses ranging from 0.2 mg/cm^2 to several mg/cm^2. (auth)

28004 ORIENTATION OF A SINGLE-CRYSTAL TARGET IN A GONIOMETER RELATIVE TO A BEAM OF HIGH-ENERGY ELECTRONS. Gorbenko, V. G.; Zhebrovskii, Yu. V.; Kovalenko, N. A.; Kolesnikov, L. Ya.; Rubashkin, A. L. (Physical Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 2, 396-398(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 2, 54-56(1973).

The position of the crystallographic planes of the target was determined by means of coherent bremsstrahlung. The experimental dependences of the total intensity of γ quanta on the rotation angles of a diamond single crystal about the vertical and horizontal axes of the goniometer are displayed. The matching of the crystal axes with the rotation axes of the goniometer is achieved by the optical method. An accuracy of $2 \cdot 10^{-4}$ rad is achieved. (auth)

28005 NUCLEAR SPECTROMETRY AT 1 GeV. Beurtey, R.; Garreta, D.; Saudinos, J.; Thirion, J. (Cen de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 179, 67-79(Mar 1973). (In French).

Nuclear physics in the 1 GeV energy-range enables nuclear structure to be studied in detail. An energy resolution of the order of 100 keV is required and is obtained with the high-resolution spectrometer SPES I at the Saclay Saturne synchrotron, using systematic compensations for spurious effects (energy dispersion of incident beam, kinematic compensations), and using simple methods to get good optical characteristics of the magnets and to detect scattered particles. (FR)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 27035, 27404, 27407, 27408, 27491, 27495–27501, 27504, 27505, 27507, 27517, 27530, 28078–28081, 28299, 28308, and 28729.

28006 LARGE UNDERGROUND SHOWERS AND MULTIPLE MUONS IN ASSOCIATION WITH EAS. Chowdhuri, B.; Saxena, Y. C. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 77: No. 5, 212-225(May 1973).

An investigation on the showers, produced by high-energy muons at a depth of 580 m.w.e. of Kolar Gold Field was carried out. It was found that in most of the cases it was possible to interpret the events as electromagnetic cascades accompanied by high-energy muons which are present at the underground level. A few underground showers were found to be accompanied by multiple penetrating particles 3 or more in number with projected linear spread of $\gtrsim 40$ cm. (auth)

28007 EFFECTS OF IONS ON VLF AND ELF PROPAGATION IN AN ABNORMALLY IONIZED ATMOSPHERE. Agarwald, D. C. (Allahabad Univ., India). J. Inst. Telecommun. Eng.; 18: No. 5, 191-193(1972).

The propagation of elf and vlf waves in abnormally ionized lower atmosphere has been studied. The absorption of these waves in whistler mode propagation has been calculated for three disturbed conditions (PCA event, solar flares, and nuclear explosion) and ambient condition of the lower ionosphere. It is found that due to enhanced ion density, elf waves suffer more absorption than that suffered by vlf waves. (Indian Sci. Abstr.)

28008 UNDERGROUND MUON SHOWERS AND MODELS OF THE HADRONIC INTERACTION AT VERY HIGH ENERGIES. Lowe, G. H. III. Salt Lake City; Univ. of Utah (1973). 98p. University Microfilms Order No. 73-19,607.

Thesis (Ph.D.).

Measurements of the intensity of underground muon showers up to multiplicity 9 in 80 m^2 and 20 m^2 detectors with depths ranging from 2000 hg/cm^2 to 6000 hg/cm^2 were made. The data have far greater statistical accuracy than any previous experiments. The intensities are compared to previous work and are shown to be reasonably consistent with them. Comparisons are made with two models of the hadronic interaction, scaling and a model proposed by Cocconi, Koester, and Perkins (CKP). It is shown that the predictions of the CKP model as calculated by the Durham cosmic ray group are inconsistent with the data without drastically increasing the mean transverse momentum. Comparison with the isolated perliminary points of a scaling model calculation by Elbert and Mason shows somewhat better agreement with the data. Suggestions are made on which parameters might serve as logical points of contact between theory and measurement in future model calculations. (auth)

28009 SIZE SPECTRA OF EXTENSIVE AIR SHOWERS AND PRIMARY COSMIC-RAY SPECTRUM. Saxena, Y. C. (Physical Research Lab., Ahmedabad, India). Nuovo Cim.; 17B: No. 1, 53-63(11 Sep 1973).

Results on the size spectra of the extensive air showers, in the size range $10^5 < N < 10^7$, recorded with two different triggering requirements, are presented. The differential size spectrum for showers recorded by means of a fourfold coincidence between the EAS array detectors is represented by $F(N)dN = (1.01 \pm 0.10) \cdot 10^{-10}\ (N/10^5)^{-2.78 \pm 0.05} dN\ m^{-2}\ s^{-1}$. The spectrum for the showers recorded in association with at least one muon of energy ≥ 150 GeV, at an underground detector, is expressed as $\varphi(N)sN - (1.15 \pm 0.30) \cdot 10^{-13}\ (N/10^5)^{-2.30 \pm 0.10} dN\ m^{-2}\ s^{-1}$. The difference in the power indices of two spectra indicates a functional relation of the type $n_\mu(\geq 150\ GeV, N) \propto N^{0.48}$ between the number of muons of energy ≥ 150 GeV and the shower size. The primary cosmic-ray spectrum in the energy range $5 \cdot 10^{14} \leq E_p \leq 2 \cdot 10^{16}$ eV, as obtained from the size spectrum of the EAS, is represented by $J(\geq E_p) = (3.74 \pm 0.20) \cdot 10^{-10}\ (E_p/10^{15})^{-2.16\ 0.10}\ cm^{-2}\ s^{-1}\ sr^{-1}$. The spectrum compares well with the spectrum obtained in other experiments and confirms the existence of a change in the logarithmic slope in the neighborhood of 10^{15} eV. (auth)

28010 CALCULATION OF COSMIC-RAY MODULATION IN COSMIC SPACE. Dorman, L. I.; Kobilinski, Z. Kosm. Luchi; No. 13, 108-134(1972). (In Russian).

The modulation of galactic cosmic rays is studied on the assumption that the diffusion coefficient is reduced whereas the solar-wind velocity is increased with the growth of the angle θ (between the Sun's rotation axis and the direction of solar plasma motion). The stationary plane problem of isotropic diffusion is solved as applied to two cases: with and without due account of particle retardation by the antiphermium mechanism. This problem is solved by the grid method in the polar coordinate system. The calculation results are followed by the discussion of the solution method and the errors. The change in the solar-wind characteristics upon the angle θ affects only slightly the galactic cosmic-ray modulation, with the parameter $d = \frac{2}{3} \cdot U_0 r_0 \kappa_0$ varying between 0.02 and 5.0, where r_0 = the radius of the body under consideration; γ_0 and U_0 are the diffusion coefficients and the solar-wind velocity in the helioequator plane, respectively. (auth)

28011 COSMIC-RAY STUDY BY MEANS OF ARTIFICIAL MOON SATELLITES "LUNA-11" AND "LUNA-12". Grigorov, N. L.; Kurt, V. G.; Lutsenko, V. N.; Maduev, V. L.; Pisarenko, N. F.; Savenko, I. A. Kosm. Luchi; No. 13, 135-148(1972). (In Russian).

In the period from the end of August 1966 to January 1967, the primary cosmic radiation fluxes beyond the terrestrial magnetosphere were measured by means of the equipment mounted on satellites "Luna-11" and "Luna-12". The altitude dependence of cosmic rays near the lunar surface as well as the intensity of protons and electrons of solar origin in the Moon's vicinity were determined. The paper considers the general variation time of the intensity of protons with $Ep \geq 50$ MeV and $Ep > 1.8$ MeV throughout the period from August 28 to October 1, 1966 and from October 25, 1966 to January 5, 1967. The solar flares (August 28 and September 2) were followed by sharp increases of proton fluxes. The correlation of proton intensity on parameters characterizing the solar and geomagnetic activities; and the peculiarities of angular distribution of the proton flux as revealed during measurements are given. Data on electron fluxes studied on September 1 and 8, 1966, when short-term increases in the electron intensity were observed, are given. (auth)

28012 COSMIC RAYS ON THE PROTON SERIES OF ARTIFICIAL EARTH SATELLITES. Grigorov, N. L.; Savenko, I. A.; Basilova, R. N.; Volodichev, N. N.; Voropaev, S. I.; Kalinkin, L. F.; Kakhidze, G. P.; Labutin, V. A.; Melioranskii, A. S.; Prayakhin, E. A.; Rapoport, I. D. Kosm. Luchi; No. 13, 149-161(1972). (In Russian).

Investigations were carried out with space stations of the "Proton" series to study the physics of cosmic rays. "Proton-1" and "Proton-2" were identically equipped, and the programs of measurements differed in minor and unessential details. Mounted on the "Proton-3" were the SEZ device for searching for the particles with a fractional electric charge, and the SEZ-11 device for measuring high-energy electrons. The mode of action of the SEZ-11 differed from that of the SEZ-12 employed on the "Proton-1" and "Proton-2" for similar purposes. Some of the results obtained are presented. (auth)

28013 MEASUREMENT OF PROTON SPECTRA FROM THE COSMOS SERIES OF ARTIFICIAL EARTH SATELLITES. Kovalev, E. E.; Ostroumov, V. I.; Skvortsov, S. S.; Smirennyi, L. N. Kosm. Luchi; No. 13, 161-164(1972). (In Russian).

In 1966–1967 measurements were performed at altitudes from 200 to 400 km to determine the fluxes and spectra of protons by means of nuclear emulsions of the BR-2 and YA-2 types. The proton spectra within the range of up to 8 BeV are presented. The spectra obtained are the basis for estimating radiation hazard. (auth)

28014 EFFECT OF THRESHOLD RIGIDITY VARIATIONS ON THE RATE OF ELECTRON PRODUCTION IN THE ATMOSPHERE. Dorman, L. I.; Krupitskaya, T. M.; Tyasto, M. I. Kosm. Luchi; No. 13, 98-101(1972). (In Russian).

Current systems formed during magnetic disturbances cause threshold energy variations of cosmic-ray particles. The latter, in turn, are a source of electron production in the terrestrial atmosphere. The electron production rate is calculated taking into account the threshold energy variations during magnetic disturbances. (auth)

28015 POSSIBILITY OF CONTROLLING THE EARTH'S NEGATIVE CHARGE AND UNITARY VARIATION OF THE EARTH'S ELECTRIC FIELD BY COSMIC RAYS. Bragin, Yu. A.; Vorontsov, S. S.; Kocheev, A. A. Kosm. Luchi; No. 13, 96-98(1972). (In Russian).

The dependence of the atmospheric conductivity upon the cosmic-ray intensity, possibility of charge generation in thunder-

storms by cosmic rays, dependence of the troposphere electricity on the stratosphere, relationship between the unitary variation of the Earth's electric field intensity and that of cosmic ray intensity (daily, yearly, and 11-year latitudinal dependence of both values), deny, first, the exceptional role of the tropospheric processes in maintaining the terrestrial charge and unitary variation, and, secondly, compel one to consider the above cause to be the result of influence of cosmic rays. (auth)

28016 COSMIC-RAY EFFECT ON THUNDERSTORM ELECTRICITY. Bragin, Yu. A. Kosm. Luchi; No. 13, 94-95(1972). (In Russian).

The inflow of charges of small ions, formed by cosmic rays, into thunderstorm cells is estimated on the basis of rocket measurements of ionic concentrations below 90 km. Out of the two processes that form the thunderstorm charge (generation and separation of charges), the former is supposed to be caused by cosmic rays, and the nature of separation is assumed to be the same as in other thunderstorm theories. (auth)

28017 ALTITUDE, DIURNAL, AND LATITUDE DEPENDENCES OF IONIC CONCENTRATIONS FORMED IN STRATOSPHERE AND MESOSPHERE BY CORPUSCULAR STREAMS. Bragin, Yu. A. Kosm. Luchi; No. 13, 92-94(1972). (In Russian).

On the basis of over 15 rocket measurements of ionic concentrations below 80 km the authors compare the height, daily and latitudinal dependences between positive ionic concentrations and cosmic-ray intensity below 60 km as well as between ionic concentrations and corpuscular streams in the 60 to 80-km altitude range. It is shown that ionic concentration and cosmic-ray intensity below 60 km at night are likely to be interrelated in conformity with Chapman's theory of the simple layer. In the daytime all the phenomena are aggravated by photodetachment and ion exchange reactions with participation of ozone. Between 60 to 80 km, aside from ordinary cosmic rays, there must exist an additional corpuscular stream. (auth)

28018 ATMOSPHERIC EFFECTS AND SIDEREAL–DIURNAL VARIATIONS IN THE EXTENSIVE AIR SHOWERS. Efimov, N. N.; Krasil'nikov, D. D.; Nikol'skii, S. I.; Shamsutdinova, F. K. Kosm. Luchi; No. 13, 87-90(1972). (In Russian).

The results of observations recorded during 1959–1964 on the variations of the extensive air shower intensity with an average power of 1.4×10^4 and 1.4×10^5 particles at sea level are presented. The effect of disintegrating particles and the essential role of cascades formed above the lower third of the atmosphere are examined. However the authors failed to discover anisotropy of initial particles with an energy of 10^{14} to 10^{15} eV with an accuracy of up to 0.1%. (auth)

28019 COMPARISON OF RESULTS OF SIMULTANEOUS MEASUREMENTS OF COSMIC RAYS IN STRATOSPHERE AT OLENIA AND APATITY STATIONS. Lazutin, L. L. Kosm. Luchi; No. 13, 90-92(1972). (In Russian).

The results of regular measurements of the cosmic-ray intensity in the stratosphere obtained by the Olenia and Appatity high-latitude stations during September–December 1966 are compared. The agreement between the results obtained by closely located stations by means of various radiosondes RK-2 and RKL-5 is estimated. The assumption of substantial contribution of auroral x radiation to the fluctuation of the radiosonde counting rate at high altitudes is confirmed. (auth)

28020 SOLAR ACTIVITY AND ITS RELATION WITH SOME PARAMETERS OF THE PHENOMENA OF THE GEOPHYSICAL COMPLEX. Razmadze, T. S.; Chkhetiya, A. M. Kosm. Luchi; No. 13, 80-86(1972). (In Russian).

Results of a detailed analysis of solar activity in 1957–1965 are compared with the data on solar activity with variations of cosmic-ray activity, and geomagnetic, ionospheric, and terrestrial currents. Cosmic-ray variations are investigated with reference to the asymmetry of solar hemispheres. All storms in the IGY period are classified and a symbolic diagram of time sequence is drawn up. (auth)

28021 SOLAR ACTIVITY AND COSMIC RAYS IN 1963–1965. Zusmanovich, A. G.; Kolomeets, E. V.; Chumbalova, R. A.; Shakhova, Yu. A. Kosm. Luchi; No. 13, 73-77(1972). (In Russian).

The results of investigations on the interrelation between the cosmic-ray intensity and different indices of the solar activity during January 1963 to June 1965 are examined. (auth)

28022 THEORY OF COSMIC-RAY VARIATIONS. Dorman, L. I. Kosm. Luchi; No. 13, 5-66(1972). (In Russian).

Integral multiplicities and coupling coefficients for meson–nucleon and electron–photon components were calculated on the basis of contemporary notions about nuclear–meson cascades of cosmic rays in the terrestrial atmosphere. Calculations were performed in reference to the primary nucleons, α particles, and heavier nuclei incident at different angles to the zenith. Information about the relation between the solar activity and large-scale characteristics of the solar wind during an 11-year cycle is given. The results thus obtained allow to determine the size of the spiral field, distance from the Sun to the effective border of the solar wind with the interstellar magnetic field, transport travels for dispersion of particles of different energies, and characteristics of the regular and irregular components of the interplanetary magnetic field at various distances from the Sun up to 100 to 200 AU. The pure energy spectrum of the cosmic rays is discovered beyond the solar system and it is shown that the low-energy cosmic rays play a significant role in limiting the solar wind spreading. The true chemical composition and the Sun's generation spectrum are determined on the basis of the nuclear composition and energy spectrum of the solar cosmic rays. Possible mechanisms of generation of chromospheric flares are discussed and the role of nuclear interrelations is estimated. Also discussed are possibilities of extraflare generation of solar cosmic rays and cases of abrupt increases, predominantly in heavy nuclei. The initial anisotropic and isotropic stages of solar cosmic-ray diffusion in the interplanetary space are studied on the basis of the kinetic equation and anisotropic diffusion equation, respectively. The characteristics of the interplanetary space thus obtained are compared with the results of direct observations in the region adjacent to the Earth's orbit and with the results of explorations of the 11-year and 27-day variations of the cosmic rays in more distant regions. (WDM)

28023 ENERGY SPECTRUM OF GALACTIC ELECTRONS IN THE 2×10^{10} TO 2×10^{11} eV ENERGY RANGE. Zatsepin, V. I.; Rubtsov, V. I.; Svirzhevskii, N. S. Kosm. Luchi; No. 13, 67-68 (1972). (In Russian).

New experimental data on the energy spectrum of galactic electrons up to the energies $\sim 2 \cdot 10^{11}$ eV were obtained in the summer of 1967 by a scintillation telescope lifted to the stratosphere at 32 km. The geometrical factor of the telescope was 1200 sq. cm steradians, i.e., three times as great as the geometrical factor of previously employed installations. The results confirm the previous measurements and are in disagreement with the data obtained by Daniel and Stephens. (auth)

28024 DISTORTION OF THE ALTITUDE DEPENDENCE AND ENERGY SPECTRUM OF NEUTRON COMPONENT NEAR THE EARTH'S SURFACE. Gorshkov, G. V.; Tsvetkov, O. S. Kosm. Luchi; No. 13, 226-228(1972). (In Russian).

The results of altitude distribution of slow (cadmium difference) and fast (supercadmium) neutrons from 2,000 m down to the sea level are given. The neutron energy spectrum is calculated by the cadmium ratio. (auth)

28025 EFFECT OF THERMAL NEUTRON FIELD SLAGGING CAUSED BY CYLINDRICAL COUNTERS IN DIFFUSION MEDIA. Gorshkov, G. V.; Tsvetkov, O. S.; Yakovlev, R. M. Kosm. Luchi; No. 13, 229-232(1972). (In Russian).

During investigations of the cosmic-ray neutron component and, particularly, during absolute measurements of the slow neutron intensity and the rate of neutron formation, as well as in the course of relative measurements by use of a group of parallel counters immersed into a moderator, a question arises of how to include the distortions of the thermal neutron field introduced by the counters. The paper sets forth the results of calculations performed by means of the diffusion theory and transport approximation (1st collision method) in addition to the experimental data of the effect of distortions of the density of the thermal neutron flux which takes place every time when the SNM-8 and SNMO-5 type counters are placed in the diffusive media (paraffin, water, plexiglas). The reduction of the density of the thermal neutron flux is proved to be substantial and should be included during investigations. For instance, the SNM-8 type counter immersed in the water will have a ratio: $\varphi_R/\varphi_\infty = 0.76$. Where φ_R is density of thermal neutron flux on the counter surface; φ is flux density in the absence of counter. (auth)

28026 COSMIC-RAY MOTION IN COSMIC SPACE NEAR THE EARTH. Budilov, V. K.; Ivanov, V. I.; Kozak, L. V.; Mirkin, L. A.; Tsukerman, I. G. Kosm. Luchi; No. 13, 232-235 (1972). (In Russian).

Data are presented on experimental installations developed in the laboratory of cosmic-ray variations in Kazgu (Alma-Ata). Various experiments on modelling the interaction of plasma with geomagnetic field as well as plasma distribution in quiet and disturbed fields are described. The characteristics of the mesonic supertelescope using scintillators (effective area of 10 sq. m) for vertical alignments designed to study microvariations of the cosmic rays and their interrelation with magnetospheric fluc-

tuations as well as for study of solar-wind parameters are given. (auth)

28027 DETERMINATION OF COUPLING COEFFICIENT AT VARIOUS ZENITH ANGLES ON THE BASIS OF COSMIC-RAY AZIMUTH EFFECT. Bel'skii, S. A.; Dmitriev, B. A.; Romanov, A. M. Kosm. Luchi; No. 13, 236-238(1972). (In Russian).

The value of EW asymmetry and coupling coefficients at different zenith angles were measured by means of a double coincidence crossed telescope which gives an opportunity to measure simultaneously the intensity of the cosmic-ray hard component at the zenith angles from 0 to 84° in opposite azimuths. The advantages of determining the coupling coefficients by the cosmic-ray azimuth effect as compared to their measurements by the latitudinal effect are discussed. (auth)

28028 MEASUREMENT OF SUPERSMALL QUANTITIES OF ^{37}Ar AND ^{3}H. Kocharov, G. E.; Naidenov, V. O. Kosm. Luchi; No. 13, 238-240(1972). (In Russian).

The results of measurements on supersmall quantities ^{37}Ar and ^{3}H by low-background installation based on miniature (ϕ1, 3, 4 mm) proportional counters are presented. The article considers the sensitivity limit for registering ^{37}Ar and ^{3}H. (auth)

28029 THEORY OF FLUCTUATIONS OF EXTENSIVE AIR SHOWERS. Dedenko, L. G. Kosm. Luchi; No. 13, 243-245 (1972). (In Russian).

The calculation was based on the following model of the elementary event: interaction paths of nucleons are 90 g/cm^2 and of pions are 120 g/cm^2. The nonelasticity coefficient for nucleons is uniformly distributed between 0.1 and 0.9, while for the pions it is equal to 1. Isobaric pions are included. The spectra of secondary particles were determined according to the Cocconi's approximation formula. The calculation of the nuclei was made on the assumption of break up of a nucleus to component nucleons. The mean numbers of particles and dispersions of distribution for electrons at a fixed number of muons, and for muons at a fixed number of electrons have been calculated. A comparison is made with the experiment. The best correspondence can be obtained for the primary composition which is the same as that at low energies. (auth)

28030 MEASUREMENT OF SPECTRA AND NEUTRON FLUXES FROM THE COSMOS SERIES OF ARTIFICIAL EARTH SATELLITES. Dudkin, V. E.; Kovalev, E. E.; Novikova, N. R.; Potapov, Yu. V.; Skvortsov, S. S.; Smirennyi, L. N. Kosm. Luchi; No. 13, 164-166(1972). (In Russian).

In 1966-1967 measurements were carried out at the altitudes of 200 to 400 km to determine the spectra and fluxes of fast neutrons inside the hermetically sealed artificial terrestrial satellites of the "Cosmos" series. Employed as detectors were nuclear emulsions of the P9 and BR types, and emulsion of the P9 type, filled with Li and B. Spectra and fluxes of neutrons in the range of energies from thermal up to 10 MeV are presented. Also estimated are neutron doses. (auth)

28031 USE OF SUPERCONDUCTIVE SYSTEMS FOR ANALYSIS OF COSMIC-RAY COMPOSITION. Anashkin, O. P.; Belitskii, B. M.; Brodskii, V. B.; Kurnosova, L. V.; Mikhailov, N. N.; Razorenov, L. A.; Sidyakina, T. M.; Fradkin, M. I. Kosm. Luchi; No. 13, 166-168(1972). (In Russian).

The experimental results on the use of superconductive systems on board the spaceships are described. To ensure low temperatures in the cryostat under weightlessness helium was used at a pressure above the critical one (a pressure of 2.4 atm and initial temperature of 5.2°). In flight, the temperature was controlled at six points while the pressure and intensity of magnetic field were controlled in the solenoids. The methodical test proved it possible to mount special installations, on satellites, with extensive magnetic fields based on superconductive alloys and, particularly, low weights and low power consumption magnetic analyzers. (auth)

28032 INTERACTIONS OF NEUTRAL AND CHARGED PARTICLES. Kim, V. M. Kosm. Luchi; No. 13, 169-170(1972). (In Russian).

Preliminary experimental data on the number of charged and neutral nuclear-active particles were obtained by the Tien-Shan installation at 200 BeV. The ratio of the number of charged particles to the number of neutral particles was 2.1 ± 0.3. Nuclear-cascade curves in iron and distributions over the portions of energy transferred to neutral pions in lead were obtained for avalanches generated by charged and neutral particles. The characteristics of interactions of the charged and neutral particles at the existing experimental errors showed no difference. (auth)

28033 DETECTOR OF HEAVY NONRELATIVISTIC PARTICLES AT SEA LEVEL. Gal'per, A. M.; Gomozov, V. A.; Iyudin, A. F.; Kotov, Yu. D.; Luchkov, B. I.; Prilepin, A. A.; Rogovskii, A. I. Kosm. Luchi; No. 13, 174-176(1972). (In Russian).

A detector of heavy nonrelativistic sea-level particles is described. Selection of events is based on the dependence of the particle path on particle mass at a given speed. Used as speed selectors are Cherenkov counters, with $\beta = 0.59$. Mounted above the detector is a scintillation counter for measuring the ionization caused by a particle. The particle track is registered by spark chambers. (auth)

28034 POSSIBILITY OF CONSTRUCTION OF A STABILIZING PLATFORM OF COSMIC RAY STATION. Akhmadeev, I. A.; Bednazhevskii, V. M.; Tolpygin, E. P. Kosm. Luchi; No. 13, 176-180(1972). (In Russian).

The feasibility of constructing platforms for stabilizing cosmic-rays stations on spacecraft using a three-stage universal joint is considered. The stabilization system consists of three independent electrohydraulic drives. Hydrocylinders of the PGU-3B type are recommended as actuating mechanisms for horizontal stabilization, while hydromotors PM No. 2.5 A or MR = 0.25/10, MR – 0.4/10, MR – 0.63/10, are recommended for azimuth stabilization. The PD No. 1.5 pump is used as a variable capacity pump. (auth)

28035 EFFECT OF ELECTRON DIVERGENCE IN AIR GAPS ON MEASUREMENT OF CASCADE ENERGY IN EMULSION CHAMBERS. Apanasenko, A. V.; Baradzei, L. T.; Kanevskaya, E. A.; Smorodin, Yu. A. Kosm. Luchi; No. 13, 182-185(1972). (In Russian).

The effect of increase in electron density in the vicinity of the cascade axis caused by an avalanche passing through the gap between lead filters of the emulsion chamber was experimentally investigated. Optical densities were measured in circles with radii 48, 58, 84, and 140 mk in three x-ray films spaced at 400, 800, and 1200 mk from the filter surface having a thickness of 6 cascade units. The optical densities were measured for blackening spots caused by electron–photon cascades of 1 to 2, 2 to 7 and >7 BeV energies. The number of electrons were calculated inside the circles with radii 25, 50, 100, and 150 mk in three showers with energies 4.4×10^{11}, 7×10^{11} and 10^{12} eV found in three layers of 400 micron nonunderlayed nuclear emulsion. The results prove the presence of a gap between the filter and the nuclear emulsion which results in the underestimation of energy by several tens of per cent. (auth)

28036 DISCREPANCIES IN THE 27-DAY AND 11-YEAR VARIATION OF THE COSMIC RADIATION IN CONNECTION WITH THE PARAMETERS OF THE SOLAR ACTIVITY. Bazilevskaya, G. A.; Okhlopkov, V. P.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1264-1269(Jun 1973). (In Russian).

The 27-day variation of the cosmic radiation is correlated with the parameters of solar activity. The time delay of the change of the parameters of the solar activity is shown. A relation between the amplitudes of the 27-day and 11-year variations is derived. (JSR)

28037 FORBUSH EFFECT IN THE NUCLEAR COMPONENT OF THE PRIMARY COSMIC RADIATION IN AUGUST 1972. Volodichev, N. N.; Likin, O. B.; Savenko, I. A.; Suslov, A. A.; Ustinovshchikov, V. M. (Inst. of Nuclear Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1195-1197(Jun 1973). (In Russian).

The Forbush effect in protons and nuclei with $Z \geq 2.6$ and 15 and $E \gtrsim 500$ MeV/N was registered on Aug. 4, 1972, by the Cherenkov counter on the Prognoz-2 sputnik. The amplitudes of the Forbush effect were 55 ± 3% for nuclei with $Z \geq 6$ and 75 ± 6% for nuclei with $Z \geq 15$. The counting rate of protons and nuclei with $Z \geq 2$ sharply increased through ~5 hrs after the beginning of the Forbush effect. (tr-auth)

28038 PHENOMENA IN THE COSMIC RADIATION IN AUGUST 1972. Krymskii, G. F.; Kuz'min, A. I.; Kozlov, V. I.; Samsonov, I. S ; Skripin, G. V.; Filippov, V. A.; Filippov, A. T.; Shafer, G. V.; Chirkov, N. P.; Transkii, I. A. (Inst. of Cosmophysical Research and Aeronomy, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1205-1210(Jun 1973). (In Russian).

The data of the Yakutsk complex from the underground muon telescope and from the ground-level instruments of the series of stations were investigated from August 2 to August 8, 1972. The energy dependence of the Forbush decrease was determined. The results of the model calculation for the explanation of the variation of the cosmic radiation from August 4 to August 5 are reported. (tr-auth)

28039 PRELIMINARY RESULTS OF THE STUDY OF THE VARIATION OF THE COSMIC RADIATION IN AUGUST 1972. Alaniya, M. V.; Belov, A. V.; Blokh, Ya. L.; Dorman, L. I.;

Eroshenko, E. A.; Inozemtseva, O. I.; Kaminer, N. S.; Rodionov, A. V.; Shatashvili, L. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1211-1221(Jun 1973). (In Russian).

Data of the ground-level observations of the variations of the cosmic radiation at the beginning of August 1972 were collected. Special attention was given to the hard spectrum and the anisotropic effects. The Forbush decrease, the increase of intensity connected with the period of solar radiation on the Earth, the increase of the intensity through the Forbush effects, short-period variation at the minimum of the Forbush decrease were analyzed separately. (tr-auth)

28040 INTENSITY OF COSMIC RADIATION IN THE LAST 10^5 TO 10^6 YEARS AND CONCENTRATION OF THE ISOTOPE ^{81}Kr IN THE ATMOSPHERE. Barabanov, I. R.; Gavrin, V. N.; Golubev, A. A.; Pomanskii, A. A. (Inst. of Nuclear Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 37: No. 6, 1186-1188(Jun 1973). (In Russian).

The atmospheric concentration of the radioactive isotope ^{81}Kr with a half life of 2×10^5 years was measured. The measured activity of ^{81}Kr is equal to 0.10 ± 0.03 decays $\cdot l^{-1} kg^{-1} min^{-1}$. It was shown that the rate of formation of ^{81}Kr in the atmosphere under the influence of cosmic radiation is no greater than 0.04 atoms $\cdot l^{-1} kg^{-1} min^{-1}$. (tr-auth)

28041 STUDY OF THE COSMIC RADIATION ON THE SPUTNIK PROGNOZ. Vernov, S. N.; Grigorov, N. L.; Likin, O. B.; Logachev, Yu. I.; Pisarenko, N. F.; Savenko, I. . ; Volodichev, N. N.; Suslov, A. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1138-1143(Jun 1973). (In Russian).

The preliminary results are reported on the measurement of the cosmic radiation in the Prognoz sputnik. The daily mean values of the current of particles of different energy measured during the active existence of the sputnik are graphed. Among them were those for protons with energies E > 1 to 5 MeV, >15 MeV, and >30 MeV, for electrons with energy E ~ 50 to 500 keV, and absorbed radiation dose. (tr-auth)

28042 STUDY OF THE PRIMARY γ RADIATION IN THE DIRECTION OF THE NORTH GALACTIC POLE. Gal'per, A. M.; Kirillov Ugryumov, V. G.; Luchkov, B. I.; Ozerov, Yu. V. Izv. Akad, Nauk SSSR, Ser. Fiz.; 37: No. 6, 1144-1149(Jun 1973). (In Russian).

The results of the scanning of discrete sources of γ radiation measured by the Kosmos-264 in Jan. 1969 are described. The spark γ telescope is first described. The processing of the events recorded is described. The upper limits of the current of γ quanta from a series of objects, calculated on the basis of these measurements, are reported. The isotropic diffuse current with energy $E_\gamma \geq 100$ MeV was measured as $I_{dif} = 6 \pm 6 \times 10^{-5}$ cm^{-2} sec^{-1} $sterad^{-1}$. (JSR)

28043 ROLE OF PLASMA EFFECTS DURING PROPAGATION AND ISOTROPIZATION OF COSMIC RADIATION IN THE GALAXY. Ginzburg, V. L.; Ptuskin, V. S.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1150-1154(Jun 1973). (In Russian).

The different instabilities, arising in the directional movement of cosmic radiation (proton-nuclear components), in interstellar plasma were examined. The basic results of the calculation of the increments of different types of waves of weakly anisotropic protons of cosmic radiation are reported. The oscillation of the wave with the cosmic radiation or other sources leads to the existence in interstellar space of different types of turbulent pulses. The range of applicability of the linear theory is determined by taking into consideration the nonlinear processes. (JSR)

28044 NOVA AND SUPERNOVA AS SOURCES OF RELATIVISTIC PARTICLES. Rumyantsev, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1155-1158(Jun 1973). (In Russian).

The possibility of the generation of relativistic cosmic particles in plasma in which low-frequency turbulences and MHD collision waves occur was examined. It is shown that the conditions necessary for the formation of such turbulences occur in the shell of novae and supernovae in flare processes. (tr-auth)

28045 EFFECTS OF NUCLEAR REACTIONS WITH FAST PROTONS IN THE SHELL OF SUPERNOVAE AND THE ORIGIN OF COSMIC RADIATION. Lavrukhina, A. K.; Kuznetsova, R. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1159-1164(Jun 1973). (In Russian).

On the basis of data on the abundance of isotopes in carbonaceous chondrites and on the cross section of the nuclear reactions with fast protons a quantitative evaluation was made of the contribution of these reactions to the abundance of elements in the matter of the solar system. (tr-auth)

28046 MEASUREMENT OF THE NEUTRON CURRENT ALBEDO OF GALACTIC COSMIC RADIATION ON THE SPUTNIK MOLINYA-1 IN 1972. Razumov, Yu. A.; Shavrin, P. I.; Samonenko, Yu. A.; Kurillo, I. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1310-1312(Jun 1973). (In Russian).

The results of the measurement of the neutron current albedo on Molinya-1 at the perigee of the trajectory at latitudes $\geq 60°$ are reported. The neutron current albedo, extrapolated to the atmospheric limits was 0.72 ± 0.16 neutrons cm^{-2} sec^{-1} in the period from December 1970 to January 1971. (tr-auth)

28047 STUDY OF THE ISOTROPIC AND ANISOTROPIC EFFECTS OF COSMIC RADIATION IN OCTOBER-NOVEMBER 1968. Belov, A. V.; Blokh, Ya. L.; Dorman, L. I.; Eroshenko, E. A.; Inozemtseva, O. I.; Simsar'yan, R. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1276-1287(Jun 1973). (In Russian).

From the data of the world network of neutron monitors the variation of the cosmic radiation in the interplanetary space from October to November 1968 was separated out and studied. The isotropic component intensities and the north-south asymmetry were studied particularly. (tr-auth)

28048 DIURNAL, SEMIDIURNAL, AND EIGHT-HOUR COMPONENTS OF THE ANISOTROPY OF COSMIC RADIATION. Asylbaeva, S. D.; Gonchar, G. A.; Zusmanovich, A. G.; Kolomeets, E. V.; Mirkin, L. A.; Siyunyaeva, N. V.; Chumbalova, R. A. (Kazakh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1288-1292(Jun 1973). (In Russian).

The time dependence of the amplitude-phase characteristics of the diurnal, semidiurnal, and 8-hr components of the anisotropy of the cosmic radiation during the 11-year solar cycle was reported. Correlations were made of the annual change of the solar-diurnal and semidiurnal variation with the annual variation of the solar activity. A model is given connecting the changes of the amplitude and phase of the solar-diurnal anisotropy with the change of the velocity of solar-wind. (tr-auth)

28049 EVALUATION OF THE SPECTRUM OF THE VARIATION OF THE COSMIC RADIATION IN THE HIGH-ENERGY RANGE ACCORDING TO DATA OF UNDERGROUND OBSERVATIONS. Bishara, A. A.; Dorman, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1293-1296(Jun 1973). (In Russian).

According to the data of underground observations of cosmic radiation under different conditions by the ratio method by means of bond coefficients, the energy spectra of the 11-year, 27-day, solar-diurnal variation, and the Forbush decrease were evaluated in the high-energy range. Four forms of the spectra were examined. Theoretical interpretations of the results obtained are given. (tr-auth)

28050 SCANNING OF THE SHORT-PERIOD VARIATION OF THE COSMIC RADIATION AT THE LATITUDE OF MOSCOW. Sborshchikov, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1331-1333(Jun 1973). (In Russian).

The short-period variation in the frequency range from 2 to 60 hr^{-1} was studied with the meson telescope at the latitude of Moscow. The spectral density of the power of the variation in the range from 2 to 60 hr^{-1} was obtained. It is shown that the amplitude of the variation in the range from 4 to 60 hr^{-1} is less than 0.01%. (tr-auth)

28051 CONTRIBUTION TO THE THEORY OF COSMIC-RAY PROPAGATION WITH ANISOTROPIC PARTICLE SCATTERING. Zakharchenko, V. F. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 11-15(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 14-19(1973).

The Fokker-Planck kinetic equation was formulated for cosmic rays in interplanetary space, allowing for anisotropic particle scattering by a random magnetic field in the presence of a regular field. In a homogeneous medium, the stationary angular distribution of particles with energies below critical is nonisotropic. In the energy range of the order of tens of MeV, the transverse diffusion coefficient (relative to the regular field) is anomalous and may be many times greater than the longitudinal coefficient. The paper discusses the possibility of obtaining information on an irregular magnetic field from measurements of cosmic-ray anisotropy outside the source. (auth)

28052 MODULATION OF GALACTIC COSMIC-RAYS BY SOLAR WIND WHICH IS UNSYMMETRIC IN SOLAR LATITUDE. Dorman, L. I.; Kobilinski, Z.; Khadakhanova, T. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 16-20(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 20-25(1973).

A model is discussed which takes into account the dependence of the cosmic-ray diffusion coefficient on the distance to the Sun. The isotropic diffusion equation is solved by allowing for convective transfer and adiabatic cooling of cosmic rays in interplane-

tary space. The asymmetry of the solar wind in solar latitude is also considered. The expected cosmic-ray density distribution was determined at different distances from the Sun and from the plane of the solar equator, as were the expected values of the radial and longitudinal components of the cosmic-ray gradient in interplanetary space. (auth)

28053 MEASUREMENT OF RELATIVISTIC INCREASE IN PRIMARY IONIZATION CAUSED BY A CHARGED PARTICLE IN A STREAMER CHAMBER. Davidenko, V. A.; Dolgoshein, B. A.; Semenov, V. K.; Somov, S. V. Kosm. Luchi; No. 13, 171-173(1972). (In Russian).

The relative contribution of the secondary ionization to the measured one depending on the time of delay of the high-voltage pulse supply is estimated. (auth)

28054 CURRENTS OF ELECTRONS WITH ENERGIES E> 10^7 eV AT ALTITUDES FROM 200 TO 500 km. Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Klyachko, A. V.; Kogan-Laskina, E. I.; Lupenko, G. V.; Nagornykh, Yu. I.; Pryakhin, E. A.; Pugacheva, G. I.; Savenko, I. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1297-1301(Jun 1973). (In Russian).

The results of the measurement of the high-energy electron currents by Proton-4 and Kosmos-490 are reported. The data are presented in the form of electron spectra in the energy interval from 0.03 to 3.5 GeV at the equator and at latitudes with hardness R < 2 GeV/c. The latitude path of the electrons of the excess radiation was derived. (tr-auth)

28055 ISOTOPIC LEAD AGES OF CHONDRITIC METEORITES. Tilton, G. R. (Eidgenoessische Technische Hochschule, Zurich). Earth Planet. Sci. Lett.; 19: No. 3, 321-329(Jul 1973).

The isotopic composition of lead was determined for two carbonaceous, two H, and two L chondrites. All are falls. The $^{206}Pb/^{204}Pb$ ratios cover a range from 9.45 to 37.33; the $^{207}Pb/^{204}Pb$ ratios range from 10.39 to 26.10. The isotopic data define a $^{207}Pb/^{206}Pb$ age of 4.635 AE. Uranium and lead concentration data indicate that the isotopic lead ages for the Bruderheim chondrite are concordant within approximately 20%. This contrasts with lead data in the literature for chondrites, which consistently indicate discordant isotopic lead ages due to large excesses of radiogenic lead by factors of two or more. The isotopic lead ages for Pultusk may be concordant; those for a sample of Richardton are not. The lack of concordance for Richardton is not due to the analytical procedures, rather it is likely a result of the handling history of the chondrite prior to analysis. The L-3 chondrite, Mezo-Madaras contains such a high concentration of lead—5.27 PPM—that accurate ratios for primordial lead can be obtained. These are $^{206}Pb/^{204}Pb = 9.310$; $^{207}Pb/^{204}Pb = 10.296$, values which are in close agreement with a recently reported measurement on lead in troilite from the Canyon Diablo iron meteorite. (auth)

28056 ^{60}Co IN LUNAR SAMPLES. Wahlen, M.; Finkel, R. C.; Imamura, M.; Kohl, C. P.; Arnold, J. R. (Univ. of California, San Diego). Earth Planet. Sci. Lett.; 19: No. 3, 315-320(Jul 1973).

Concentrations of the (n, γ)-produced radionuclide ^{60}Co were measured in lunar samples at various depths from the surface down to 360 g/cm^2. By comparing the data obtained to calculated production rates (based on the work of Lingenfelter et al. (1972) the present day lunar neutron production rate, was found to be (12 ± 3) neutrons/cm^2 sec (E < 10 MeV). (auth)

28057 DEPTH DISTRIBUTION OF HYDROGEN IN LUNAR MATERIALS. Leich, D. A.; Tombrello, T. A.; Burnett, D. S. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 19: No. 3, 305-314(Jul 1973).

A technique employing the resonant nuclear reaction $^1H(^{19}F,\alpha\gamma)^{16}O$ has been used to measure hydrogen concentration versus depth in selected coarse fine fragments from the Apollo 11 and Apollo 15 missions, and in glass coated surface chips from two Apollo 15 rocks. The highly variable hydrogen content in the coarse fine fragments is concentrated mainly in a layer extending from the surface to a depth of 2000 ± 500 Å. The hydrogen content of the surface region of the Apollo 15 rock chips is comparable to that of the coarse fine samples, but is concentrated mainly within a few hundred angstroms of the surface. The hydrogen depth distribution in a piece of platinum foil from the Apollo 16 Lunar surface Cosmic Ray Experiment was also measured in an attempt to place a limit on the flux of 10 to 40-keV protons associated with a solar flare event. (auth)

28058 CHARACTERISTICS OF TRACKS OF IONS OF 14 Z ≤ TO 36 IN COMMON ROCK SILICATES. Price, P. B. (Univ. of California, Berkeley); Lal, D.; Tamhane, A. S.; Perelygin, V. P. Earth Planet. Sci. Lett.; 19: No. 3, 377-395(Jul 1973). Earth Planet. Sci. Lett.; 19: No. 3, 377-395(Jul 1973).

The identification of heavy ion tracks in minerals by measurements of track-etch rates and total etchable track lengths is considered. With beams of Si, Cl, Ti, Fe, Zn, and Kr at energies up to 10.35 MeV/N nine minerals commonly used to study fossil cosmic-ray tracks in meteorites and lunar samples were irradiated. From the measurements of etched track length as a function of residual range, response curves were determined for various minerals as a function of ionization rate, using the expression previously derived by Price, Fleischer, and Moak. These curves increase smoothly with ionization rate instead of rising abruptly at some critical value as was previously thought. It is shown that the track etch rate concept accounts qualitatively for total etchable track length distributions, but that the positions of the peaks of different elements in these histograms occur at shorter lengths for fossil tracks than for fresh tracks. The annealing data indicate that, at maximum lunar surface temperatures, tracks in olivine, orthopyroxenes, and feldspars may be significantly shortened whereas tracks in clinopyroxenes will not be affected. Additional evidence is cited that gradual rearrangement of radiation damage at ambient temperature makes the properties of fresh tracks and of ancient tracks different. It is thus not surprising that the histograms of fresh and fossil tracks do not match perfectly. (auth)

28059 CHARACTERISTICS OF THE INFLUENCE OF SOLAR WINDS ON THE INTENSITY OF COSMIC RADIATION IN 1969. Belov, A. V.; Dorman, D. I.; Shatashvili, L. Kh. Kosm. Issled.; 11: No. 3, 418-430(1973). (In Russian).

In 1969 attention was drawn to the relatively complete data on the characteristics of solar winds and the large quantity of data on cosmic radiation of different energy. Preliminary analysis among the abundance of the different effects characterizing the high levels of solar activity in 1969 showed an inclination to repetitions in the reduction of the intensity of the cosmic radiation with periods near to the period of rotation of the Sun. The initial task was the investigation of the variation of the 27-day type but in the course of the work the necessity of a very detailed examination of the modulations of the cosmic radiation by solar activity was shown. (tr-auth)

28060 MEASUREMENT OF PROTONS WITH ENERGIES UP TO 50 MeV IN THE ATMOSPHERE. Dudkin, V. E.; Levkovskii, A. A.; Ostroumov, V. I.; Petrov, V. M. Kosm. Issled.; 11: No. 3, 492-494(1973). (In Russian).

The results of the measurement of protons with energies up to 50 MeV measured during the balloon flights of Feb. 24 to March 4, 1970, at a latitude of 64° are reported. The energy spectra and the angular distribution of the protons are graphed. These protons can be primary cosmic radiation, secondary protons from the spallation of N and O, or protons from the decay of secondary neutrons. Calculations showed that the contribution of the primary cosmic radiation to the size of the measured proton current is ~1.2×10^{-3} particles/cm^{2}sec-sterad. Estimations showed that the protons from the decay of neutrons gives a contribution to the total current of at least two orders of magnitude lower. (JSR)

28061 MUON COMPONENT OF EXTENSIVE AIR SHOWER NEAR THE SHOWER AXIS. Il'ina, N. P.; Kalmykov, N. N.; Oleinichak, Ya.; Khrenov, B. A.; Khristiansen, G. B.; Yarochkina, Z. V. (Moscow State Univ.). Yadern. Fiz.; 18: No. 1, 118-132 (Jul 1973). (In Russian).

The work is fulfilled at the Moscow State University EAS complex set-up. Space distribution of muons with energy $E_\mu \geq 10$ GeV was studied by means of the spark and hodoscope detectors, put at the depth of 40 m water equivalent, for the showers with the particle numbers $2 \cdot 10^5 \leq N_e \leq 6 \cdot 10^5$ and $6 \cdot 10^5 \leq N_e \leq 2 \cdot 10^6$, for three values of the shower age S (S ≤ 1, 1 < S ≤ 1.2, and S > 1.2), at the distances of r ≤ 20 m from the shower axis. A correlation between the muon space distribution and the age S is found at fixed values of N_e. Groups of parallel muons were studied. It is shown that the parallel muon groups on the spark chamber area $\sigma_1 \approx 4m^2$ may be explained with fluctuations of the muon space distribution function near the axis of EAS. (auth)

Stars

Refer also to abstract 28676.

28062 UBVR PHOTOMETRY OF STARS IN THE GLOBULAR CLUSTERS M92, M13, AND 47 TUCANAE. Cathey, L. R. Santa Cruz, CA; Univ. of California (1973). 209p. University Microfilms Order No. 73-21,198.

Thesis (Ph. D.).

Photoelectric UBVR photometry is presented for stars of the subgiant, giant, and asymptotic giant branches in the globular

clusters M92, M13, and 47 Tucanae. The increased ultraviolet excess of the stars of the subgiant branch in M92 over that of the stars of the asymptotic giant branch found by Sandage and Walker is shown to be largely the result of errors in the U photographic photometry. These errors are possibly the result of (1) an inadequate treatment of the scattered background light within the cluster, (2) a color equation in the photographic U magnitude, producing a spurious transformation to the standard system, and (3) a calibration error arising from the similar treatment of the photographic magnitudes of red and blue stars. It is demonstrated that the small observed separation (about 0.02 m) of the subgiant branch from the asymptotic giant branch in the (U−B, B−V) diagrams can be completely explained by small differences in surface gravity resulting almost entirely from differences in radius at a fixed temperature between the two sequences. The B−V and V−R color indices are found to be equally good temperature indicators within each cluster except for some red variable stars in 47 Tucanae, where V−R is a better indicator. (Diss. Abstr. Int. B)

28063 UBV PHOTOMETRY OF THE GRONINGEN−PALOMAR VARIABLE STAR FIELDS. Wehinger, P. A.; Hidajat, B. (Case Western Reserve Univ., Cleveland). Astron. J.; 78: No. 5, 401-407 (Jun 1973).

UBV photoelectric sequences were established for 170 stars in the four Groningen−Palomar variable star fields covering the range 6 to 18 visual magnitude. On the average, three to four stars per magnitude interval were observed in each field. Three of the fields are close to the galactic plane ($b = +12°, +11°$, and $-10°$), while the fourth field is above the plane ($b = +29°$). An analysis of the extinction data and of the photometric errors associated with the Kitt Peak observations is presented. Special types of field stars brighter than $B \simeq 12.0$ mag were determined using objective-prism plates. The visual absorption as a function of distance was computed out to 1300 pc for the brighter stars. (auth)

28064 NGC 1893 AND NGC 6838, STANDARD STARS. Cuffey, J. (New Mexico State Univ., Las Cruces). Astron. J.; 78: No. 5, 408-409(Jun 1973).

Photoelectric magnitudes and colors in the UBV system for 56 stars in NGC 1893 and for 13 stars in NGC 6838 are given along with identification charts. (auth)

28065 UBV LIGHT VARIATION AND ORBITAL ELEMENTS OF HD 101799. Sistero, R. F.; Castore de Sistero, M. E. (Univ. Nacional de Cordoba, Argentina). Astron. J.; 78: No. 5, 413-421 (Jun 1973).

Photoelectric UBV observations of the W UMa system HD 101799 are presented; they were made at Cerro Tololo Inter-American Observatory (Chile) in April 1971. The period and linear ephemeris were obtained from 14 times of minimum observed in each color. The eclipses show flat minima during an interval of 31 min. Primary minimum is an occultation. Consistent orbital elements were determined for the three light curves based on the Russell model. (auth)

28066 AXIAL RATIO AND POSITION ANGLE OF THE MAJOR AXIS FOR THE GLOBULAR CLUSTER M92. Hoegner, W.; Kadla, Z. I.; Richter, N.; Strugatskaya, A. A. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 843-845(1973).

Translated from Astron. Zh.; 49: No. 5, 1033-1036(1972).

The method of equidensity curves is used to determine the axial ratio and orientation of the major axis at various angular distances from the center of the globular cluster M92. (auth)

28067 SPECTRAL ENERGY DISTRIBUTION IN SEVERAL BINARIES AT λλ 3300 TO 7300 A AND 0.88 TO 1.53μ. Glushneva, I. N. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 846-852(1973).

Translated from Astron. Zh.; 49: No. 5, 1037-1045(1972).

Six visual and spectroscopic binaries were investigated in order to derive their absolute spectral energy distribution. In the visible region (λλ3300-7300 Å) the observations were made with the AZT-14 telescope equipped with a concave-grating spectrometer of the Seya−Namoika type. The infrared spectra (0.88-1.53μ) were recorded with a prism spectrometer mounted on the 125-cm reflector of the Southern Station, Shternberg Astronomical Institute. There is a good fit between the measurements in the two regions, and they also agree satisfactorily with Johnson's wide-band observations. The behavior of the relative infrared energy distribution of the binaries is examined. (auth)

28068 CYCLES OF ACTIVITY IN RU CAMELOPARDALIS AND AN EVOLUTIONARY INTERPRETATION OF ITS PHOTOMETRIC BEHAVIOR. Zaitseva, G. V.; Lyutyi, V. M.; Efremov, Yu. N. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 856-860(1973).

Translated from Astron. Zh.; 49: No. 5, 1049-1054(1972).

The composite light curve of RU Cam for 1966-1971 shows that the periods of quiescence, when only small aperiodic fluctuations with an amplitude less than 0.1 m remain, have become more protracted. Probably the star will never become a Cepheid again. There is evidence for a systematic decrease in the color index of RU Cam (by 0.05 m in the past 20 yr) and in its period (since 1890 a monotonic decrease with a quadratic term of 0.000031 d has been superimposed on irregular period fluctuations). The diminishing amplitude, period, and color index and the peculiarity in chemical composition can all be explained by the same hypothesis: RU Cam may be a star moving rapidly leftward in the H−R diagram due to mixing of material in its interior during the red-giant stage, and it may now be crossing the left-hand edge of the instability strip. (auth)

28069 REVISED VERSION OF THE INGLIS-TELLER FORMULA. Mitrofanov, A. V. (Inst. for Physical Problems, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 867-869 (1973).

Translated from Astron. Zh.; 49: No. 5, 1063-1065(1972).

Kurochka has given an equation for the number of resolvable Balmer-series lines, based on modern line-broadening theory, which affords an estimate for the electron density in a hydrogen plasma. In Kurochka's opinion N_e should be 3 to 10 times smaller than the value given by the familiar Inglis−Teller equation. This claim is here shown to be incorrect, and over a wide range of T_e and N_e Kurochka's equation actually yields the same value of N_e as the Inglis−Teller equation. The reasons for this coincidence are discussed. (auth)

28070 EFFECTIVE EXCITATION CROSS SECTIONS OF Ne I AND Ne II LINES IN THE ULTRAVIOLET. Smirnov, Yu. M.; Sharonov, Yu. D. (Moscow Power Engineering Inst.). Sov. Astron. AJ (Engl. Transl.); No. 5, 900-903(1973).

Translated from Astron. Zh.; 49: No. 5, 1102-1106(1972).

The cross sections for excitation of 35 Ne I and 38 Ne II lines by electron collision were measured for electron energies ranging from threshold to 350 eV. These lines cover the wavelength region 2700 to 3700 Å. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

28071 (AD-762002) OBSERVATIONS OF RECOMBINATION LINE EMISSION IN THE DIRECTION OF TWO SUPERNOVA REMNANTS. II. Cesarsky, D. A.; Cesarsky, C. J. (Owens Valley Radio Observatory, Pasadena, Calif). 1973. Contract N00014-67-A-0094-0019. 14p. NTIS.

Recombination line emission was detected in the direction of the supernova remnant 3C 391 at 18 cm and 21 cm and in the direction of remnant 3C 398 at 21 cm. The spectrum of 3C 391 shows three emission features, one of which may be due to carbon recombination emission. The spectrum of 3C 398 shows a hydrogen line at the same radial velocity as a recently reported carbon line in the same general direction. The observations suggest that the line emission originates in the cold component of the interstellar medium. (NTIS)

28072 (TID-3320(S3)) PULSARS. Bibliography. Matheny, W. D. (Technical Information Center (AEC), Oak Ridge, Tenn.). Aug 1973. 129p. Dep. NTIS $5.45.

This bibliography consists of 770 abstracts taken from Nuclear Science Abstracts, Vol. 26 and Vol. 27. The time period covered is 1972. For papers covering the period up to 1972, see TID-3320 and TID-3320 (Suppl. 1 and 2). (auth)

28073 ENERGETICS OF REISSNER NORDSTROEM GEOMETRIES. Denardo, G. (Univ., Trieste, Italy); Ruffini, R. Phys. Lett.; 45B: No. 3, 259-262(23 Jul 1973).

The existence of a generalized ergosphere in the Reissner Nordstrøm geometry is pointed out, and an explicit formula to determine its range is given. These results are compared and contrasted with the ones obtained in the case of the Kerr solution. An explicit process of energy extraction from a Reissner Nordstrøm black hole is given. (auth)

28074 COMPTON-SCATTERING EFFECTS IN A MOVING GAS. Morozov, Yu. I. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 782-789(1973).

Translated from Astron. Zh.; 49: No. 5, 954-964(1972).

When analyzing a rarefied, moving, high-temperature gas interacting strongly with radiation that is emitted, one ordinarily uses a system of equations of radiational hydrodynamics and radiative transfer. Equations for the components of the radiative energy−momentum tensor are derived from the relativistically

covariant transfer equation, including terms describing the Compton effect in a hot moving electron gas. In the Thomson scattering approximation, which holds when the radiation is not in equilibrium with the gas, exact equations are obtained for the case of a relativistic equilibrium electron distribution. In the case of Compton scattering the nonrelativistic approximation is adopted, both for the electron velocity distribution and for the macroscopic gas motion; effects of order $(kT_e/m_ec^2)^{3/2}$ and $(v_m/c)^2$ are neglected, where kT_e is the mean thermal energy of the electrons, m_ec^2 is the electron rest-mass energy, and v_m is the macroscopic velocity of the electrons. (auth)

Solar Phenomena

Refer also to abstracts 28020, 28021, 28036, 28117, 28160, and 28660.

28075 (NRC-TT-1681) INVESTIGATION OF LOCAL REGIONS OF SOLAR RADIO RADIATION BY POLARIZATION OBSERVATIONS IN THE MICROWAVE BAND. Korol'kov, D. V.; Soboleva, N. S.; Gel'freikh, G. B. Translation by H. R. Hayes from Izv. Gl. Astron. Observ. Pulkove; 21: No. 164, 81-112(1960). 69p. Dep. NTIS (U. S. Sales Only) $5.50.

Observations of the polarization of radio radiation from local sources on the Sun have been carried out in the microwave band at Pulkovo Observatory since 1956. Methods are described for analyzing polarized radiation and the operating principles of certain specific polarization receiver schemes used in the observations. Difficulties encountered in investigating the nature of the polarization due to the large background of unpolarized radiation from the Sun as a whole are also discussed. The observations were carried out with low-resolution antennae during solar eclipses and with the Large Pulkovo Radiotelescope. It was found that groups of sunspots are associated with regions of increased radio radiation in which the brightness temperature reaches several million degrees. The radiation from these regions is, as a rule, polarized in a circle, the degree of polarization being as much as several tens per cent. The regions of polarized radiation have sharply defined boundaries and their size is approximately the same as the nuclei of corresponding groups of spots. The radiation from these regions is relatively stable; the flux, as a rule, varies little during the lifetime of the group. Assuming that the radiation has a thermal mechanism, it is possible to determine the magnetic field, kinetic temperature, and density in the regions of radiation which are situated at altitudes between 0.05 and 0.07 $R_\odot$ above the photosphere. The article describes methods of determining these characteristics, and evaluations are made on the basis of the observed data. (auth)

28076 RELATION BETWEEN COSMIC-RAY CHEMICAL COMPOSITION AND RADIOSPLASH DURATION SPECTRUM. Tsimakhovich, N. P. Kosm. Luchi; No. 13, 69-72(1972). (In Russian).

The comparison of durations of the centimeter and meter components of the radio bursts corresponding to chromospheric flares with known chemical composition of radiated nuclei has shown a greater duration of the centimeter component for the bursts wherein protons are dominating, and vice versa. A conclusion is made about the interrelation of heavy nucleus emission and the processes which occur in the upper layers of the solar corona. (auth)

28077 COSMIC-RAY BURST ON JANUARY 28, 1967. Chirkov, N. P.; Krymskii, G. F.; Samsonov, I. S.; Ipat'ev, V. I. Kosm. Luchi; No. 13, 77-80(1972). (In Russian).

The solar cosmic-ray burst which took place on January 28, 1967 is analyzed. Energy responses and diffusion coefficient ($D = 6.5 \cdot 10^{21}$ sq. cm/sec^{-1}) are determined. Periodic variations of the cosmic rays with an amplitude of 0.10 to 0.20% and a period of 35 to 40 min are discovered during the decrease phase of the burst. (auth)

28078 SOME SINGULARITIES OF THE 27-DAY CHANGE OF THE ANISOTROPY OF COSMIC RADIATION. Shatashvili, L. Kh.; Pankratov, A. K. (Inst. of Geophysics, Tbilissi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6 1270-1275(Jun 1973). (In Russian).

The 27-day variation of the anisotropy of the neutron component of cosmic radiation during the IGY was studied. The maximum of the amplitude of 27-day anisotropy is reached in five revolutions of the Sun (at the peak of the maximum of the solar activity). Before the complete disappearance of the 27-day oscillation of the anisotropy, the vector of the diurnal variation draws carefully some of the whoris after one revolution of the Sun. (tr-auth)

28079 11-YEAR CYCLE OF THE INTENSITY OF COSMIC RADIATION IN THE STRATOSPHERE AND ITS DEPENDENCE ON THE SOLAR ACTIVITY. Charakhch'yan, A. N.; Bazilevskaya, G. A.; Sbirzhevskaya, A. K.; Stozhkov, Yu. I.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad Nauk SSSR, Ser. Fiz.; 37: No. 6, 1258-1263(Jun 1973). (In Russian).

The energy spectrum of the 11-year variation of the cosmic radiation is shown. Some quantitative relations between the intensity of the cosmic radiation in the stratosphere and in outer space are derived. Anomalies observed in the 11-year cycle are described. (tr-auth)

28080 KINETIC DESCRIPTION OF THE INTERACTION OF COSMIC RADIATION WITH COLLISION WAVES. Dorman, L. I.; Kats, M. E.; Shogenov, V. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1254-1257(Jun 1973). (In Russian).

It was shown previously that the intensity of the cosmic radiation increases from 1 to 3% several hours before the beginning of a magnetic storm and the Forbush decrease connected with it. The effect of the increase was explained by the reflection of the cosmic particles on the leading front of the strong collision waves moving to the Earth from the Sun. In the present study this phenomenon is examined on the basis of the kinetic equation. (JSR)

28081 INVESTIGATION OF THE COLLISION WAVES RESPONSIBLE FOR THE FORBUSH DECREASE. Dorman, L. I.; Kaminer, N. S.; Kuz'micheva, A. E. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1241-1253(Jun 1973). (In Russian).

The dependence of the time delay of the Forbush decrease on the longitude of the flare was determined. The north–south asymmetry of the effect of the increase is shown. The velocity of the collision waves in interplanetary space was determined. The forms of the collision waves were determined from data on the effect of the increase. (JSR)

28082 SOME CHARACTERISTICS OF THE SOLAR FLARE IN AUGUST 1972, GENERATING COSMIC RADIATION, PLASMA CLOUDS, AND INTERPLANETARY COLLISION WAVES. Krivsky, L.; Pintør, S. (Astronomical Inst., Ondrejov, Czech.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1189-1194(Jun 1973). (In Russian).

The proton flare in August 1972, which caused powerful interplanetary geophysical disturbances and effects, is discussed. The basic data on the flare and its characteristic radiation which can be assumed to be the source of the effects are reported. The moments of emission of the fast particles from the volume of the flare are reported. Data are also given on the transmission of collision waves at distances of 0.77, 1.0, and 2.2 AU from the Sun. (tr-auth)

28083 POWERFUL FLARE OF SOLAR COSMIC RADIATION IN AUGUST 1972. Bazilevskaya, G. A.; Stozhkov, Yu. I.; Charakhch'yan, A. N.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1198-1204(Jun 1973). (In Russian).

The experimental data are reported and the singularities of the flare at the beginning of August were observed. On August 2 the current of solar protons with $E \geq 200$ MeV reached 60 cm^{-2} sec^{-1} sterad^{-1} in the stratosphere. The time dependence of the increase suggests the arrival of the particles in a trap. The propagation of the cosmic radiation in the flare of August 7 took place as the result of the usual diffusion. (tr-auth)

28084 RESULTS OF THE MEASUREMENT OF THE SOLAR PROTONS IN AUGUST 1972. Borovkov, L. P.; Vashenyuk, E. V.; Lazutin, L. L.; Khor'kov, V. D. (Polar Inst. of Geophysics, Apatity, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1222-1227(Jun 1973). (In Russian).

The effects in the cosmic radiation at the beginning of August 1972 from the data of the ground-level complex and stratospheric measurements in the Apatit were examined. The causes of the phenomena described follow for a while a series of chromospheric flares in the highly active region appearing on the eastern circle of the solar disk at the beginning of August. (tr-auth)

28085 ISOTOPES OF HYDROGEN AND HELIUM IN THE SOLAR CORPUSCULAR CURRENTS. Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1228-1234(Jun 1973). (In Russian).

An attempt was made to examine three problems: (1) isotopic composition of the solar wind; (2) nuclear reactions on the surface of the Sun and isotopes of He and H in solar cosmic radiation; and (3) solar neutrinos. (tr-auth)

28086 NONLINEAR AND NONSTATIONARY EFFECTS IN THE SOLAR WIND. Shister, A. R.; Shabanskii, V. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1235-1240(Jun 1973). (In Russian).

The nonstationary flow of the plasma of the solar wind was examined in the framework of weak hydrodynamics. In interplanetary space local increases of the density of the plasma and magnetic field occur. (tr-auth)

28087 PREFERENTIAL ACCELERATION OF HEAVY NUCLEI ON THE SUN. Konyakhina, S. S.; Kurnosova, L. V.; Logachev, V. I.; Razorenov, L. A.; Fradkin, M. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1165-1168(Jun 1973). (In Russian).

The question on the relation of currents of different groups of nuclei of solar cosmic radiation, registered at different periods of time in the energy intervals E > 400 to 600 MeV/N and E = 40 to 100 MeV/N, was examined. (tr-auth)

28088 PROPAGATION OF PROTONS, INJECTED NEAR 1 AU, IN MEDIA WITH CONSTANT TRANSPORT MEAN FREE PATH. Gorchakov, E. V.; Timofeev, G. A.; Morozova, T. I.; Osipova, L. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1169-1173(Jun 1973). (In Russian).

The propagation of protons in media with constant transport mean free path was studied and the data from proton flares were analyzed by the Monte Carlo method. It was concluded that almost all the recorded particles coming from the Sun (~80%) were primary. The registered time variation of the intensity of the protons can be completely explained by their scattering on magnetic inhomogeneities without any of their generation at distances ≥1 AU. The transport mean free path strongly decreases with time both during one flare and from flare to flare. (JSR)

28089 DETERMINATION AND INTERPRETATION OF THE SPECTRA OF SOLAR PROTONS ON THE GROUND AND AT THE SOURCE. Miroshnichenko, L. I.; Petrov, V. M.; Tibanov, A. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1174-1180(Jun 1973). (In Russian).

The methods for the determination of the absolute current of solar cosmic radiation in the region of hardness R ≳ 1 GV from ground measurement data by means of the absolute value of the integral multiplicity of the generation for neutron components were examined. Algorithms and calculation programs were developed and the absolute spectra of the solar protons on the ground were calculated for a series of flares from 1956 to 1967. (tr-auth)

28090 STRUCTURAL AND DYNAMIC SINGULARITIES OF THE PENETRATION OF SOLAR COSMIC RADIATION IN THE POLAR REGIONS. Darchieva, L. A.; Ivanova, T. A.; Sosnovets, E. N.; Tverskaya, L. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1313-1317(Jun 1973). (In Russian).

The dynamics of the penetration of solar particles with E_p > 1 MeV and E_e > 50 keV in the polar regions of the magnetosphere were investigated on the basis of experimental results obtained from Kosmos-480 during the event of April 18, 1972. The basic experimental results were the following: during about 10 hrs of April 18 asymmetry of the intensity of the solar protons was observed at the north and south polar caps. The difference in the intensity at the caps was an order of magnitude. The solar protons fill the polar magnetosphere irregularly. A significant difference in the intensities on the polar plateau and in the low-latitude regions of the polar caps was observed. Substantial differences in the intensity at the polar caps were not observed for electrons. These experimental data are discussed. (JSR)

28091 SIMULTANEOUS RECORDING OF SOLAR COSMIC-RAYS NEAR VENUS AND THE EARTH'S MAGNETOSPHERE. Vernov, S. N.; Ivanova, T. A.; Kuznetsov, S. N.; Logachev, Yu. I.; Lopatine, G. B.; Sosnovets, E. N. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 136-137(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 164-165(1973).

During the flight of Venera 5 and 6 toward Venus, solar cosmic rays were recorded in the Earth's magnetosphere by Kosmos-256 which had a circular polar orbit with a height of about 1200 km. Data from the three vehicles for E_e > 50 keV and E_p > 50 MeV are compared. (WDM)

28092 EFFECT OF NONSTATIONARITY IN THE CHEMICAL COMPOSITION OF PLASMA FLOWS FROM THE SUN. Veselovskii, I. S. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 138-140(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 166-167(1973).

The average composition of the solar wind in the undisturbed state near the Earth's orbit is characterized by a ratio of the density of alpha particles to that of protons $N_2/N_1 \approx 0.04$ to 0.05. A few days after a strong flare on the Sun, an increase in proton density and velocity is observed near the Earth's orbit. After another few hours, the arrival is recorded of a plasma enriched with helium, in some cases to the extent of over 20%. This sequence of the observed phenomena may be due to an unsteady process of motion of the plasma ejected from the Sun during a flare. (WDM)

28093 MEAN FREE PATH IN THE TRANSITION REGION BEYOND THE BOUNDARY OF THE MAGNETOSPHERE. Kovner, M. S. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 140-142(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 168-170(1973).

It is assumed that to a first approximation the flow in the transition region has a hydrodynamic character. The effect of the spontaneously formed magnetic field on the plasma motion is neglected. On the basis of the theory presented Landau and Lifshitz (1967) it is assumed that the magnetic energy is concentrated in small eddies with a scale l_m of the order of the correlation length of the angular rotational velocity of the gas; l_m is also the distance at which the viscosity is significant. Within this framework, knowing the characteristic values of the magnetic field from the experiment, one can estimate a series of parameters of the transition region, and also the internal scale determining the front thickness of the shock wave. The results obtained are in good agreement with experiment. (WDM)

28094 SELECTION OF A PROPAGATION MODEL FOR CALCULATING THE INJECTION SPECTRUM OF SOLAR PROTONS. Miroshnichenko, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 21-24(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 26-30(1973).

In reference to the problem of determining the injection spectra of solar protons, three models of propagation of solar cosmic rays are analyzed: model I with diffusion coefficient $\varkappa$ independent of the distance to the Sun; model II with $\varkappa = \varkappa_0 (r/r_\odot)^\beta$, where $0 \le \beta \le 1$; model III of anisotropic diffusion considering the solar coordinates of the flare and the degree of disturbance of interplanetary plasma. It is shown that a combination of models II and III is the most reasonable for calculating injection spectra. The accuracy of determination of injection spectra is discussed. (auth)

28095 POWERFUL CHROMOSPHERIC FLARES AND ROTATIONAL DISCONTINUITIES IN THE SOLAR WIND. Afanas'yeva, V. I.; Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 7-10(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 10-13 (1973).

The appearance of intense rotational solar-wind discontinuities is compared with the presence of powerful chromospheric flares of class 2n and higher. It was found that the discontinuities appear during the period of a high flare activity and that almost every discontinuity is preceded by a flare whose location on the Sun is in accord with the expected direction of propagation of the discontinuity. The average traveling velocities of the discontinuities reaching the Earth are close to the observed values on the discontinuity front. Most discontinuities were recorded on magnetically quiet and slightly disturbed days. (auth)

28096 MAGNETOHYDRODYNAMIC WAVES IN PLASMA OF SOLAR WIND. Toptygin, I. N. (Leningrad Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 7, 971-980(1973). (In Russian).

The order of magnitudes of nonlinear decrements of magnetohydrodynamic wave attenuation in a rarefied plasma is estimated. It is found that the nonlinear decrement of a fast magneto-sonic wave depends on the amplitude as $B_a^{-\frac{1}{2}}$. The nonlinear decrement of Alfven wave at low frequencies is proportional to B_a^2, and to $B_a^{-\frac{1}{2}}$ at the high frequencies. Based on the estimations obtained it is shown that magneto-sonic waves with $\lambda \lesssim 5 \cdot 10^6$ km are damping in the interplanetary plasma at distances which do not exceed 1 AlU from the generation region. Alfven waves with $\lambda \gtrsim 10^5$ km propagate at the distances greater than 10 AlU. The changes in the parameters of Alfven waves propagating in interplanetary space are found in the geometric optics approximation. The results of calculation agree with observational data. (auth)

28097 VARIATION OF THE INTENSITY OF LOW-ENERGY PROTONS AND ELECTRONS IN THE OUTER MAGNETOSPHERE DURING SUDDEN ONSET OF MAGNETIC STORMS. Panasyuk, M. I.; Sosnovets, E. N.; Tverskaya, L. V. Kosm. Issled.; 11: No. 3, 431-435(1973). (In Russian).

The variation of the intensity of low-energy protons and electrons in high altitude lines of force during the sudden onset of a magnetic storm on Sept. 16, 1970, from observations on the Molniya-1 is discussed. The protons and electrons were registered in the following energy ranges: 130 < E_p < 250 keV, 250 < E_p < 340 keV, 340 < E_p < 420 keV, E_p > 420 keV, 1 < E_p < 5 MeV, E_e > 40 keV. An increase of the intensity of the protons with E_p > 130 keV at ~1.5 hrs. before SC was accompanied by moderation of the spectrum up to the moment of SC. After the sudden onset the current of protons with E_p > 420 keV was regenerated and the mean energy of the proton spectrum was increased, reaching a maximum after ~0.5 hrs. after SC. The

effect can be interpreted within the framework of the model of the Fisk representation on the acceleration of solar protons in the front of collision waves. (tr-auth)

28098 STRUCTURE AND EVOLUTION OF THE ASTEROID BELT. Chebotarev, G. A.; Shmakova, M. Ya. (Inst. of Theoretical Astronomy, Leningrad). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 904-906(1973).

Translated from Astron. Zh.; 49: No. 5, 1107-1111(1972).

From an examination of the structure of the asteroid belt, four main evolutionary stages are distinguished: 1) The formation along with the major planets of 10 to 100 protoplanets between the orbits of Mars and Jupiter, comparable in size to the largest surviving asteroids, and with predominantly high-inclination orbits. 2) An unstable primordial asteroid belt formed through mutual collisions of the protoplanets and occupying the zone 300-990″ (mean daily motion). Planets with exceptional orbits (Hidalgo, the Trojans) would have formed, and the wide gap (300-540″) between the asteroid belt and Jupiter's orbit would have developed gradually. 3) A stable asteroid belt in the zone 540-990″, with planets of the "spherical" subsystem predominating. The belt gradually expands toward the Sun. Most young planets are concentrated in the ecliptic plane. 4) The present asteroid belt, at 450-1110″. During its lifetime the total mass of the belt must have diminished to a fraction of its original value. (auth)

28099 SOME SINGULARITIES OF THE STUDY OF THE STREAM OF CHARGED PARTICLES BY MEANS OF CATCHERS AND ANALYZERS. II. Use of Modulation Catchers for Study of Solar Winds. Zastenker, G. N.; Khokhlov, M. Z. Kosm. Issled.; 11: No. 3, 451-459(1973). (In Russian).

The results of the calculation of the response of the modulation catcher of charged particles are reported for the case of registration of solar wind ions allowing for their real characteristics and different assumptions on the structure of the solar wind (isotopic Maxwell distribution and anisotropic bi-Maxwell distribution during normal and oblique incidence of the solar wind on the catcher). On the basis of the calculations made the possibility and precision of the determination of the different parameters of the solar wind by means of single modulation catchers and a fixed form of the orienting system of the catcher are analyzed. (tr-auth)

28100 INTERPLANETARY PROTONS AND GEOMAGNETIC DISTURBANCES. Troshichev, O. A.; Fel'dshtein, Ya. I. Kosm. Issled.; 11: No. 3, 486-488(1973). (In Russian).

An analysis of the preliminary data of the D_{St} variation led to the conclusion that each increase of the intensity of the interplanetary protons is accompanied by appearance of a weak magnetic storm and subsequently the presence of interplanetary protons is possibly a necessary condition of the development of the principal phase of a magnetic storm. A more detailed analysis led to the assumption that the solar current (responsible for the low-width dispersion of the magnetic field) and the polar magnetic disturbances are developed to a sufficient degree independent on the presence (or absence) of protons with energy $11 < E < 18$ keV. (tr-auth)

Galaxies

28101 NEW REDSHIFTS OF CIRCUMPOLAR SOUTHERN GALAXIES. de Vaucouleurs, G.; de Vaucouleurs, A. (Univ. of Texas, Austin). Astron. J.; 78: No. 5, 377-381(Jun 1973).

Redshifts of nine galaxies south of $\delta = -60°$ were determined from ten spectrograms obtained with the Page–Carnegie image-tube spectrograph attached at the Newtonian focus of the Cordoba Observatory 154-cm reflector. The reciprocal dispersions are 150 Å/mm at $H\alpha$ in the first order and 78 Å/mm at λ3727 in the second order. The derived velocities have mean errors of ~40 km sec^{-1}. The velocities are used to discuss group membership. One of the smaller and fainter galaxies, NGC 2915, has the remarkably low corrected velocity $V_0 = +154$ km sec^{-1} (two plates). (auth)

28102 ANALYSIS OF THE NEUTRAL HYDROGEN WITHIN 1 kpc OF THE SUN. Henderson, A. P. (Manhattan Coll., New York). Astron. J.; 78: No. 5, 381-386(Jun 1973).

Neutral hydrogen about the LSR is assumed to approximate a plane-parallel layer. Line profiles ($-10° \geq l \geq 250°$) are analyzed using differential motion equations and small nonuniform circular effects are found. Eight latitude positions, symmetric with respect to the plane, yield small velocities (<3 km/sec) which are found to be functions of z-position relative to the plane. The result is a "shearing" effect whereby the gas above and below the plane has a slightly different velocity from the gas closer to the plane. (auth)

28103 SPIRAL STRUCTURE AND NUCLEAR ACTIVITY IN GALAXIES. Van der Kruit, P. C. (Carnegie Institution of Washington, Pasadena, CA). Nature (London) Phys. Sci.; 243: No. 130, 127-130(25 Jun 1973).

It is stated that spiral galaxies with strong density wave compression have a lower specific angular momentum than weak compression galaxies of the same mass. Such galaxies also have a larger degree of central mass concentration and generally better development and possibly more active nuclei. (auth)

28104 OPTICAL VARIABILITY OF THE NUCLEI OF SEYFERT GALAXIES. Lyutyi, V. M. (Sternberg State Astronomical Inst., USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 763-773(1973).

Translated from Astron. Zh.; 49: No. 5, 930-942(1972).

UBV observations of the nuclei of the Seyfert galaxies NGC 1068, 1275, 3516, 4151, 5548, 7469, Markarian 10, and the N galaxies 3C 120 and IIZw 136 are presented. The observations were carried out in 1968-1971, in the main, with a 60-cm reflector with an electrophotometer, operating in the photon-counting regime. The amplitude of the variations in the brightness of the nuclei of the galaxies NGC 1275, 3516, and 4151 attains 1 to 1.5 m. The nucleus of NGC 1068 exhibits no brightness variations, while the brightness of the nuclei of the galaxies Markarian 10, NGC 5548, 7469, 3C 120, and IIZw 136 varies within the range 0.3 to 0.6 m. The maximum amplitude is in the ultraviolet region of the spectrum. The colors of the nuclei vary with brightness: At the brightness maximum the colors correspond to synchrotron radiation (in the [(U–B), (B–V)] diagram); at the brightness minimum the nuclei of the Seyfert galaxies "turn red"; the nuclei of the N galaxies 3C 120 and IIZw 136 "turn red" in the (B–V), but "turn blue" in the (U–B). The data of the UBV photometry of the variable radio galaxies NGC 1275 (3C 84) and 3C 120 are compared with radio observations at 1.9 cm. A correlation is observed between the radio and optical observations of the variability of NGC 1275 and 3C 120, and between radio, optical, and infrared observations of NGC 1275. The radio and optical variability of NGC 1275 may be connected with the variability of the infrared-radiation source. (auth)

28105 POLARIZATION OF OPTICAL RADIATION SCATTERED IN AN ABSORBING MEDIUM. Gnedin, Yu. N.; Dolginov, A. Z.; Potashnik, E. L.; Silant'ev, N. A. (Ioffe Inst. of Physics and Tech., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 809-814(1973).

Translated from Astron. Zh.; 49: No. 5, 990-997(1972).

The Stokes parameters for optical radiation emerging from an absorbing semi-infinite medium are determined. The percentage linear polarization is calculated as a function of the degree of absorption for a flat-disk envelope. The expected linear polarization of radiation at a wavelength of a few microns is calculated for the nucleus of the Galaxy, assuming that the infrared radiation of the nucleus observed at $\lambda \approx 100\ \mu$ is of thermal origin. An explanation is also given for the polarization observed in the galaxy M82. (auth)

28106 DETERMINATION OF THE TYPE OF MOTION IN SPHERICALLY SYMMETRIC CLUSTERS OF GALAXIES. Karachentsev, I. D.; Zonn, W.; Shcherbanovskii, A. L. (Special Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 815-823(1973).

Translated from Astron. Zh.; 49: No. 5, 998-1009(1972).

Theoretical regression curves are determined for the absolute value of the radial velocity of a galaxy as a function of its projected distance from the center of a spherically symmetric system, $\overline{v}(x)$ and $v^2(x)$, and of its distance from an arbitrary axis in the plane of projection, $\overline{v}(z)$ and $v^2(z)$. These regressions are established for the cases of: (1) free radial motion (system members formed simultaneously through an explosion); (2) circular motion. A brief discussion is also given of: (3) radial oscillations; (4) quasielliptic motion; (5) a nonsteady system experiencing recurrent explosions. The theoretical curves are compared with empirical regressions for the Virgo and Coma clusters and a "synthetic" group. The assumption that these systems are unstable is consistent with the observational evidence. (auth)

28107 PHOTOMETRIC PARAMETERS OF FLAT GALAXIES. Vorontsov-Vel'yaminov, B. A.; Noskova, R. I. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 5, 824-829(1973).

Translated from Astron. Zh.; 49: No. 5, 1010-1016(1972).

The photometric parameters characterizing the flat and spherical components of 130 type S0, S, and Irr galaxies are studied statistically from photometric profiles. The spherical component is much larger than the nuclear region that is prominent in direct photographs, and it is also brighter. Although the radiation and mass densities may possibly decline as the spherical component enlarges from types Sc and Sd to S0, there is a very large dis-

persion in the size and luminosity of that component within a given morphological type. The parameters overlap, and only for late-type spirals is the spherical component always small. In all cases the surface brightness of the flat component closely follows an exponential law with a mean exponent of 2.3, if the radius of the galaxy to the $26.5m/(1'')^2$ isophote is taken as unity. The dispersion in the exponent is small. The mean surface brightness of the flat component extrapolated to the center of the galaxy is found to be $21.30m/(1'')^2$ in the B system, also with small dispersion. These two related quantities show no correlation with other properties of the galaxies. The integrated magnitudes of a number of systems are estimated, corrected for inclination, and reduced to the 21.30m isophote. Evidently photometric profiles cannot be used to refine the morphological classification of galaxies. (auth)

Cosmology

Refer also to abstract 28391.

28108 (LA-UR-73-1302) ENERGY DENSITY OF THE RELICT RADIATION. Blair, A. G. (Los Alamos Scientific Lab., N. Mex.). 1973. 26p. (CONF-730929-1). Dep. NTIS $3.50.

From extraordinary general assembly of the International Astronomical Union meeting; Krakow, Poland (10 Sep 1973).

Experimental measurements of the intensity of the submillimeter background are reviewed. The latest results all indicate a low background; it is not yet possible to say whether or not the spectrum in this range is blackbody. (auth)

Planetary Phenomena

28109 (UCRL-75037) INFLUENCE OF THE SURFACE BOUNDARY LAYER ON EVOLUTIONARY MODELS OF JUPITER. (California Univ., Livermore. Lawrence Livermore Lab). 22 Aug 1973). 16p. (CONF-730931-1). Dep. NTIS $3.00.

From I. A. U. symposium no. 65, exploration of the planetary system; Warsaw, Poland (4 Sep 1973).

A recent theoretical study of the structure and evolution of Jupiter (Graboske, Pollack, Grossman, and Olness, 1973) is based on a three-stage model of Jovian evolution. The central phase, gravitational contraction of an adiabatic, homogeneous convective fluid system, begins early in solar system evolution and lasts for times of the order of 2×10^9 years. Good agreement with observed radius and luminosity is achieved for a model with a solar mixture composition. The surface boundary layer has a dominant influence on the evolutionary timescale. Surface boundary factors which are important are the solar energy input, a function of the solar luminosity and the planetary albedo, and the detailed physics of the superadiabatic zone, which depends on the variation of opacity and ∇_{ad} with depth. The evolutionary study demonstrates that the current planet cannot be an adiabatic homogeneous fluid throughout. The inclusion of a superadiabatic zone is necessary, and the existence of a heterogeneous (gravitationally layered) fluid interior is probable. (auth)

28110 ALPHA PARTICLE EXPERIMENT FOR CHEMICAL ANALYSIS OF THE MARTIAN SURFACE AND ATMOSPHERE. Economou, T. (Univ. of Chicago); Turkevich, A. L.; Patterson, J. H. J. Geophys. Res.; 78: No. 5, 781-791(10 Feb 1973).

An α particle experiment similar to the one performed successfully on the Surveyor lunar missions is described. It is designed to provide a chemical analysis of the Martian surface and atmosphere. A preprototype instrument significantly smaller than the Surveyor instrument has been constructed, and measurements demonstrating that the thin Martian atmosphere will not affect the analytical capabilities of the technique have been made. The density of the Martian atmosphere can be measured by such an instrument to better than 5%, and nitrogen, neon, and argon can be determined if the amounts are >1%. Analyses of rocks of known and unknown compositions have been made under simulated Martian conditions. The accuracies attained are generally comparable to those of the Surveyor lunar analyses. Improvements have been achieved in determining carbon and oxygen, so that a few per cent of water or carbonates in rocks can be detected. Some aspects of the integration of such an experiment with the spacecraft, a possible mission profile, and some other problems associated with a soft-landing mission to Mars are discussed. The importance of such a chemical analysis experiment in answering current questions about the nature and history of Martian surface material and its suitability for life processes is presented. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 27533, 28014, 28015, and 28017.

28111 (AD-732884) IONOSPHERIC HEATING ANALYSIS: hf PLASMA LINE ENHANCEMENTS AT ARECIBO. Technical Report, 1 October 1970–1 April 1971. Gordon, W. E.; Carlson, H. C.; Showen, R. L. (Rice Univ., Houston, Tex.). 22 Jun 1971. Contract F3062-71-C-0155. 22p. NTIS.

Remarkably strong enhancements (factors up to 10,000) of the plasma line were induced in the ionosphere by a powerful transmitter operating at the local plasma resonance frequency and observed by the incoherent scatter radar at Arecibo in January 1971. The intensities and spectral characteristics of the lines shifted upward and downward from the radar probing frequency are reported. The plasma line intensity is related to the power of the exciting wave in a nonlinear way. The enhancement is observed when the exciting wave propagates in the ordinary magneto-ionic mode, but not when the exciting wave is in the extraordinary mode. In comparison with the Boulder heating experiment, neither the ionograms nor the photometer records show strong effects. (auth)

28112 DEPENDENCE OF WHISTLER ACTIVITY ON GEOMAGNETIC LATITUDE. Rao, M.; Lalmani; Somayajulu, V. V.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 1: No. 2, 192-194(1972).

It is shown that the coupling between the ordinary and extraordinary magneto-ionic waves in the lower ionospheric regions should also be considered as one of the factors which control the dependence of whistler activity on the geomagnetic latitude. (Indian Sci. Abstr.)

28113 THEORETICAL ELECTRON DENSITY AND NEUTRAL WIND PROFILES IN THE F REGION. Deshpande, M. R. (Geophysical Observatory, Christchurch, New Zealand). Ann. Geophys.; 28: No. 4, 809-817(1972).

Neutral winds and electron densities in the F region were evaluated simultaneously for a mid-latitude station during equinox months for a medium sunspot year. There exists a strong coupling between ions and neutral winds causing diurnal asymmetry in neutral winds and vertical drifts. The computed electron density profiles and the diurnal variation of N_{max} show good agreement with the experimental data. The diurnal variation of h_{max} can be accounted for qualitatively and the reasons for this and the assumptions involved are discussed. It is suggested that the maintenance of nighttime ionization can be explained in terms of vertical drifts and the diffusive flux from higher altitudes. A flux of the order of 3.8×10^8 cm^{-2} sec^{-1} is required to maintain a N_{max} value of the order of 3.5×10^5 electrons cm^{-3}. (FR)

28114 DETECTION OF HIGH FREQUENCY MODULATION IN PRECIPITATING AURORAL ELECTRONS. Loewenstein, R. F. Houston, TX; Rice Univ. (1973). 160p. University Microfilms Order No. 73-21,571.

Thesis (Ph. D.).

Theoretical considerations indicate that auroral electrons may become bunched due to wave–particle interactions. A high time resolution (HTR) experiment designed to detect such bunching was flown above an auroral band of visual intensity of 40 kR on February 24, 1972, at 21 : 22 LT. The instrument consisted of a hemispherical electrostatic energy analyzer, an electron multiplier, and a spectrum analyzer. The geometric factor of the hemispheres was 11 cm^2-ster-keV and the energy passband was 5 to 7 keV FWHM. The spectrum analyzer swept in frequency from 50 kHz to 10 MHz with a minimum bandwidth of 50 kHz. The 5 to 7 keV fluxes during this time remained between 10^7 and 10^8/sec-cm^2-ster-keV. A 5% modulation of the downcoming flux was observed at 4.2 to 5.6 MHz at T + 211 to T + 218 seconds into the flight. This time corresponds to the position of the boundary between opposite Birkeland current sheets determined from other on-board experiments. There was also a large pitch angle anisotropy peaked at 0 to 10° at this time. It is suggested that the modulation event is related to these morphological features. (Diss. Abstr. Int., B)

28115 INVESTIGATION OF HF AURORAL BACKSCATTER OVER A BISTATIC PATH. Fahlsing, F. O. Urbana, IL; Univ. of Illinois (1972). 129p. University Microfilms Order No. 73-17,201.

Thesis (Ph. D.).

A Wullenweber antenna array was used to record stepped-frequency ionograms over a bistatic path including an auroral reflection. Energy was transmitted northward from Rome, New York. Ionograms were recorded near Urbana, Illinois, at stepped-azimuth intervals over a northerly sector. The ionograms were analyzed to determine the statistical occurrence of auroral backscatter as a function of azimuth and time delay. These data were compared with theoretical results based upon a specular reflection from an auroral curtain. A technique was developed to locate the reflection point from the time delay, azimuth and maximum frequency of a stepped-frequency auroral backscatter trace. Maps were constructed showing regions of maximum frequency of occurrence of hf auroral backscatter. Results show an equatorward shift of the backscatter region with increasing magnetic activity and suggest that reflecting surfaces are horizontally elongated along lines of constant magnetic inclination. (Diss. Abstr. Int., B)

28116 PLASMA WAVES INDUCED BY HF RADIO WAVES. Kantor, I. J. Houston, TX; Rice Univ. (1973). 176p. University Microfilms Order No. 73-21,567.

Thesis (Ph. D.).

When the ionospheric F region is illuminated with a strong O-mode hf radio wave, excitations of longitudinal plasma and acoustic waves are observed by radar scattering. The structure of the excited waves, variability with local parameters, time and experimental conditions are described. The observations are compared with the parametric instability theory. The purely growing mode, the decay instability and the images are identified in the observed spectra. The calculated threshold indicates that the hf transmitting system at Arecibo can excite these instabilities. The decay of the plasma line is shown to be given by the electron–ion collision frequency and the photoelectron Landau damping, which opens a new method of measurement of the collision frequency in the F region. The standing wave structure of the electric field near the reflection is shown to play an important role on the amplitude of the plasma line when the heater frequency is slightly below the critical frequency. The thickness of the layer producing the observed plasma line is 300 m or less. (Diss. Abstr. Int., B)

28117 ANALYTICAL APPROACH TO THE DIRECT AND REVERSE TASKS IN THE PROBLEMS OF THE EFFECT OF COSMIC RADIATION IN THE LOW IONOSPHERE. Dorman, I. V.; Dorman, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1327-1330(Jun 1973. (In Russian).

Analytical expressions were obtained for the problem of the determination of the rate of formation of electrons at different depths in the atmosphere in dependence on the energy spectrum of the particles and the hardness of the geomagnetic cutoff and for the reverse problem of the determination of the spectrum of solar cosmic radiation and the hardness of the geomagnetic cutoff with respect to the ionospheric data. (JSR)

28118 EFFECT OF CHANGING IONOSPHERIC–PROTONOSPHERIC PLASMA FLOW ON THE NIGHTTIME F REGION OF THE IONOSPHERE. Ivanov-Kholodnii, G. S.; Mikhaylov, A. V. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 39-42(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 47-51(1973).

Experimental data indicate that a plasma flow of (1 to 5) $\times 10^8$ cm^{-2} sec^{-1} enters the ionosphere from the protonosphere at night. Results of a solution of the continuity equation for electron density allowing for the flow at the upper boundary are presented. The effect of change in height h_{max} of the nighttime F layer was observed during the period of change in the magnitude of the plasma flow directed downward. (auth)

28119 ANALYTICAL MODEL OF THE NOCTURNAL NONSTATIONARY F2 REGION OF THE IONOSPHERE, AT MIDDLE LATITUDES. Fatkullin, M. N.; Deminov, M. G. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Mowcow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 43-49(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 52-58(1973).

Taking into consideration the processes of recombination and ambipolar diffusion of charged particles, an analytical solution is derived for the nonstationary continuity equation for the electron–ion gas in the case of the F2 layer at middle and high latitudes. The initial condition used was the vertical distribution of the electron concentration n_e at sunset, taken in the form of Chapman's function, and values of n_e in the lower and upper boundaries of the region were specified as the boundary conditions. (auth)

28120 QUANTITATIVE IONOSPHERIC FORECASTING. Lyakhova, L. N.; Kostina, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 50-53(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 59-63(1973).

On the basis of results obtained previously Lyakhova (1960) on the stability of critical frequencies of the F2 layer for several hours, experimental forecasts for four hours were prepared by using a series of stations in the course of a year. The forecasts were given in three different ways, and the results were compared with the actual data. Conclusions are drawn regarding the possibility of using graphical extrapolation. (auth)

28121 EFFECTIVE RADIUS OF ACTION OF A DEVICE FOR MEASURING IONOSPHERIC DRIFTS. Zakharov, V. N.; Vugmeyster, B. O.; Kokourov, V. D.; Kazimirovskii, E. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 63-65(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 74-77(1973).

The paper reports the results of synchronous measurements of horizontal drift in the ionosphere at three points during vertical and oblique radio sounding. It is shown that the average statistical characteristics of drifts do not undergo any substantial changes when the points being sounded are separated by distances of the order of 100 km. As the distance between the points increases, the scatter of the drift parameters increases, this scatter being related not only to errors of the method, but also to actual differences of the dynamic regime of the ionosphere in the regions studied. (auth)

28122 COMPREHENSIVE STUDIES OF DISTURBANCES OF MARCH 8, 1970 BASED ON OBSERVATIONS IN THE MIDNIGHT SECTOR. Vasil'kova, E. A.; Gasset, J.; Yevlashin, L. S.; Zhulin, I. A.; Cambout, F.; Kanonidi, D. Kh.; Roldugin, V. K.; Saint-Marc, A.; Starkov, G. V.; Treillou, J. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 66-71 (1973).

Translated from Geomagn. Aeron.; 13: No. 1, 78-85(1973).

A physical picture of the development of the most intense storm during the current cycle of solar activity, on March 8–9, 1970, was constructed on the basis of data on x-ray bremsstrahlung bursts obtained by means of a high-altitude drifting balloon launched in Arkhangel'sk Province, as well as data on geomagnetic variations and auroras, obtained on a network of points in the northwestern part of the European territory of the USSR. The space-time dynamics of penetration of auroral particles in the midnight sector are examined, and changes in their energy spectrum are discussed. (auth)

28123 AURORAS ON THE DAY SIDE OF THE OVAL DURING SUBSTORMS. Starkov, G. V.; Fel'dhteyn, Ya. I.; Shevnina, N. F. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 72-75(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 86-90(1973).

A study of auroras on the day side of the auroral oval was made during the IGY for different phases of substorm development. It is shown that in the growth phase, one hour before the start of a sharp intensification of an auroral substorm, a fairly distinct maximum of the glow intensity is observed. On the night side, a slight decrease of the H component of the magnetic field takes place at $\Phi \sim 70°$ during that period. The start of the expansive phase of the substorm is associated with a sharp decrease of the H component at $\Phi' \sim 65°$ and an intensification of the western electrojet. This period is accompanied by a new burst of auroral glow intensity on the day side of the oval. (auth)

28124 DIURNAL VARIATION OF THE LENGTH OF AURORAL RAYS. Dzyubenko, N. I. (Kiev State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 76-78(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 91-94(1973).

A systematic change in the average length of auroral rays during the night is explained by a change in the temperature of the auroral atmosphere. The required power of the heat sources and sinks is estimated. The required power of heat sources may be provided by the Joule dissipation of ionospheric currents. The outflow of heat is achieved as a result of macroturbulent advection and infrared radiation. (auth)

28125 AVERAGE NIGHTTIME VERTICAL PROFILE OF THE LAMBDA 6300 A ATMOSPHERIC EMISSION. Gogoshev, M. M.; Serafimov, K. P. (Astronomical Observatory, Stara Zagora, Bulgaria). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 79-82 (1973).

Translated from Geomagn. Aeron.; 13: No. 1, 95-99(1973).

Assuming that the dissociative recombination of O_2^+ and NO^+ is the chief mechanism of generation of the natural optical emission λ 6300 Å of the upper atmosphere analysis of various aeronomic reactions resulting in the formation of $O(^1D)$ atoms at various heights at night was carried out. Also studied was the deactivation of these atoms as a function of the height and phase of solar activity; the mean vertical profile of the red emission was obtained. (auth)

28126 TEMPERATURE VARIATIONS IN THE UPPER ATMOSPHERE DURING THE SOLAR ACTIVITY MINIMUM BASED ON DATA OF TOPSIDE SOUNDING OF THE IONOSPHERE. Sire, A. Sh.; Agalakov, V. S.; Torbin, S. I. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 87-90(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 100-103(1973).

The effective plasma temperature T_p at a height ~400 km was calculated from the Alouette data. The temperature of the neutral gas T_n was determined. An increase in T_p and T_n with latitude and in the region of the magnetic equator was detected. Diurnal temperature changes at 40 to 60°N are discussed. (auth)

28127 DYNAMIC MODEL OF INTERACTION OF THE F REGION OF THE IONOSPHERE WITH THE PLASMASPHERE. Kutmskaya, M. A.; Polyakov, V. M.; Klimov, N. N.; Kuznetosova, G. M.; Gershengorn, G. I. (Irkutsk State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 33-38(1973).

The paper describes the simplest nonstationary model of interaction of the ionosphere and plasmasphere, including the continuity equations for hydrogen and oxygen ions and the thermal regime for the electron gas, considering transfer processes. A strong influence of the thermal regime of the plasmasphere on the behavior of the F region of the ionosphere was observed, together with a close relationship between the state of the ionosphere at magnetically conjugate points, and also a strong influence of ion–ion collisions on the character of diffusion of oxygen and hydrogen ions. (auth)

28128 THREE-DIMENSIONAL ANALYTICAL MODEL OF ELECTRON DENSITY DISTRIBUTION OF THE QUIET IONOSPHERE. Gurevich, A. V.; Fishchuk, D. I.; Tsedilina, E. E. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 25-32(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 31-40(1973).

The article proposes a global analytical model of electron concentration distribution of the quiet ionosphere, covering the 50 to 1000 km height range. A latitude–longitude dependence of the coefficients entering into the functions describing the height dependence of the electron concentration distribution was plotted on the basis of the latitudinal variation of electron concentration profiles for night and day, and of the diurnal variation of the electron concentration at 50° latitude. (auth)

28129 RELATIONSHIP BETWEEN LARGE IONOSPHERIC INHOMOGENEITIES AND SOLAR ACTIVITY. Ovsyankin, M. A.; Smetanina, E. M. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 156-157(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 185(1973).

Kokurin and Ovsyankin (1968) noted a 27-day periodicity of the change in the apparent linear dimensions of large ionospheric inhomogeneities measured by the radioastronomical method, and indicated their relationship to solar activity. A more complete analysis of the relationship between large ionospheric inhomogeneities and solar activity is given. (WDM)

28130 CHANGES IN THE PARAMETERS OF THE OUTER IONOSPHERE CAUSED BY THE MAGNETIC STORM OF MARCH 8–10, 1970. Solodovnikov, G. K.; Migunov, V. M.; Tkachev, G. N.; Ivanov, Yu. G.; Lazarenko, V. M.; Chalaya, M. N.; Yagovkin, A. R. Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 154-156(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 183-184(1973).

The geomagnetic storm of March 8–10, 1970 was the most intense in the current cycle of solar activity. A study of the effect of this storm on the parameters of the ionosphere was made. Results are given of measurement of the total number of electrons in the mid-latitude ionosphere and measurement of the absorption of SW radio waves in the polar regions. (WDM)

28131 VARIOUS TYPES OF E_s DISTRIBUTION AT MIDDLE AND SUBAURORAL LATITUDES IN THE NORTHEAST OF THE USSR. Filippov, L. D.; Mamrukov, A. P. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 152-154(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 180-182(1973).

In order to explain the character of different types of sporadic E distribution in the northeast of the USSR, the probabilities of appearance of each type of sporadic E were determined from 15-min observations at Tixie, Batagay, Yakutsk, and Irkutsk during the period 1968-69. (WDM)

28132 IONIZATION OF THE NIGHTTIME E REGION OF THE IONOSPHERE. Rubtsov, L. N.; Solovey, B. G. (Inst. of Astro-

physics, Dushanbe, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 149-152(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 178-179(1973).

An estimate is given of the possible contribution of sporadic meteors to the ionization of the nighttime E region on the basis of experimental data obtained during the epoch of the solar activity minimum (1964). (WDM)

28133 REFLECTION OF ELECTROMAGNETIC WAVES FROM INHOMOGENEOUS ANISOTROPIC PLASMA SHEETS (NORMAL INCIDENCE). Berger, V. K. (Novosibirsk State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 145-149(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 173-177(1973).

Berger and Kim (1970) and Berger (1971) discussed the problem of reflection of radio waves from weak inhomogeneities in an isotropic plasma. The solution obtained is extended to the case of an anisotropic medium. (WDM)

28134 PERTURBATION OF ION DENSITY BY A BODY MOVING THROUGH THE IONOSPHERE. Sarychev, V. T. (Tomsk State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 143-145(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 171-172(1973).

Perturbations of particle density in the ionosphere, caused by the motion of artificial satellites, were discussed by Al'pert, et al. (1964). The addition to ion density as a result of reflection from the surface of a body was not considered in this paper. A general expression is derived below for the ion density in the vicinity of a body of arbitrary shape, taking into account the shading and reflection in the presence of a constant homogeneous magnetic field. (WDM)

28135 BREMSSTRAHLUNG X-RAY EMISSION AT SUB-AURORA LATITUDES. Zhulin, I. A.; Treiyu, Zh. P.; Gasse, Zh. Kosm. Issled., 11: No. 3, 441-446(1973). (In Russian).

With inclusion of the geomagnetic data from the combined district of the Kergelen–Arkhangel'skaya region the reason for the change of the hard spectra of the auroral electrons in the early morning sector on March 11, 1969 ($L \sim 3.8$, balloon data) is discussed. On the basis of the analysis of the space–time dynamics of the microbursts of bremsstrahlung x rays on March 11, 1969 and March 8, 1970, (midnight sector) graphs of the band of the structure of the secondary with the auroral electrojet are given. (tr-auth)

28136 QUESTION ON THE EMISSION DENSITY IN THE OUTER SPACE OF THE EARTH–ATMOSPHERE SYSTEM. Pavlov, A. V.; Permyakov, V. D.; Sitnikov, Yu. F. Kosm. Issled.; 11: No. 3, 447-450(1973). (In Russian).

Questions on the calculation of the emission density in the Earth–atmosphere system from sputnik observation data were examined in the spectral region $\Delta\lambda_1 = 3$ to 30 μm and $\Delta\lambda_2 = 8$ to 12 μm. Probably characteristics of the emission density were derived: the mathematical expectation and dispersion for the arctic, equatorial, and antarctic zones. (tr-auth)

28137 SIMULTANEOUS MEASUREMENT OF THE CONCENTRATION OF IONS AND THE INTENSITY OF CORPUSCULAR CURRENTS AT ALTITUDES OF 10 TO 70 KM. Bragin, Yu. A.; Tulinov, V. F.; Smirnykh, L. N.; Yakovlev, S. G. Kosm. Issled.; 11: No. 3, 488-489(1973). (In Russian).

Simultaneous measurements of the ion concentration and the intensity of the corpuscular current were made in June 1968 and August 1970 at heights from 10 to 70 km. Both profiles are given. The markedly higher variability and discontinuity of the profile of the concentration of the small ions in the stratosphere can be explained most likely by the change of the effective coefficient of ion recombination. (JSR)

28138 CURRENT MECHANISM OF FORMATION OF IRREGULARITIES RESPONSIBLE FOR DIFFUSION IN THE IONOSPHERIC F REGION AT HIGHER LATITUDES. Gershman, B. N.; Kamenetskaya, G. Kh. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 7, 988-996(1973). (In Russian).

A mechanism for the irregularities in the F region associated with the plasma instability with respect to low-frequency disturbances is proposed. The instability must develop in the presence of a strong enough current flowing perpendicular to the magnetic field direction. Its appearance is facilitated if the disturbances are not assumed to be purely electrostatic. This instability may be responsible for the generation of irregularities causing diffuse radio reflections from the F region (especially at higher latitudes). (auth)

28139 PLASMA-WAVE REFRACTION IN THE IONOSPHERE (IN CONNECTION WITH TOPSIDE SOUNDING OF THE IONOSPHERE). Gershman, B. N.; Krupina, A. E.; Yashin, Yu. Ya. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 7, 981-987(1973). (In Russian).

In application to propagation in the ionosphere (at heights of 800 to 2000 km) calculations were made of the group delay of plasma wave packets with frequencies close to the upper hybrid frequency ω_h. These waves are assumed to be excited by sounders on the satellite during topside sounding of the ionosphere. The differences in plasma wave refraction at $\omega_h > 2\omega_H$ and $\omega_h < 2\omega$ (ω_H is the electron gyrofrequency) are pointed out. (auth)

28140 ASSOCIATION OF ABNORMAL RADIO WAVE ABSORPTION WITH ZENITH ANGLE OF THE SUN DURING SUDDEN IONOSPHERIC DISTURBANCES. Belikovich, V. V.; Benediktov, E. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 6, 840-844(1973). (In Russian).

Based upon simultaneous measurements of abnormal radio wave absorption in the ionosphere by the radio astronomical method at the frequency of 13 MHz at a number of sites (Gorki, Arkhangel'sk, Loparskaya, Tiksi) in the period of 1966–1969, the dependence of the absorption on the zenith angle of the Sun $\Gamma(\chi)$ is determined. Assuming that the dependence $\Gamma(\chi)$ may be described by the law $\Gamma(\chi) = \Gamma_0 \cos^k \chi$ the values of the index K in the limits of 0.9 to 1.2 are found. (auth)

28141 SMALL-SCALE IRREGULARITIES OF MEAN-LATITUDE E_s REGION. Erukhimov, L. M.; Pisareva, V. V.; Uryadov, V. P. (Scientific Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 6, 873-877(1973). (In Russian).

Results are reported of the investigation of the inhomogeneous structure of the mean-latitude E_s region by analyzing the conditions of SW signal reception at 350 to 1200 km. It is shown that in this layer E_s there are the irregularities with scale $l \sim 10$ to 40 meters. (auth)

28142 O^+ AND H^+ ION HEIGHT DISTRIBUTION IN THE IONOSPHERIC F2 REGION. Deminov, M. G.; Sitnov, Yu. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 6, 878-885(1973). (In Russian).

An analytical solution of the continuity and motion equations for O^+ and H^+ ions in the F2 region is obtained in the quasi-hydrodynamic approximation for the stationary case. Recombination, charge exchange, and diffusion, assuming the diffusion velocity of both ion types be close to each other, are taken into account. The asymptotic behavior of the solution is discussed and a qualitative comparison with other papers is made. (auth)

28143 POWERFUL RADIO WAVE REFLECTION FROM THE LOW IONOSPHERE. Vilenskii, I. M.; Plotkin, V. V. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 6, 886-891(1973). (In Russian).

Nonlinear effects associated with powerful radio wave reflection from the low ionosphere are considered. For a particular model of the E region, the dependence of the radio wave reflection coefficient on the transmitter power at the frequency close to the critical frequency of the layer is calculated. The effect of artificial irregularities occurring under the action of a powerful wave on the coefficient of its reflection from the ionosphere is taken into account. The formation of a periodic structure, sharp gradients in a wave field is considered. (auth)

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Refer also to abstract 28100.

28144 SECULAR VARIATIONS OF L, B-COORDINATES. Getselev, I. V.; Gorchakov, E. V.; El'tekov, V. A. Kosm. Luchi; No. 13, 102-104(1973). (In Russian).

The calculation results of L, B-coordinates for different years from 1955 to 1967 are given. Periodic calculations of the geomagnetic coordinates for different epochs are stated to be very urgent. (auth)

28145 POSSIBLE ISOTOPE DISPLACEMENTS WITH CHANGES OF THE GEOMAGNETIC FIELD. Bulashevich, Yu. P.; Ershov, V. M.; Zakharchenko, V. F. Kosm. Luchi; No. 13, 105-107(1972). (In Russian).

The geomagnetic field of the past geological epochs was studied on the basis of observations on the rock residual magnetization. This paper evaluates the shifts in isotopic composition of some elements in the rocks affected by cosmic rays. The possibility of using the shifts in the isotopic composition for revealing geomag-

netic field inversions is discussed. Geomagnetic field inversion periods traced by the rock residual magnetization are in good agreement with the periods of the greatest qualitative changes in the animal world throughout the last 500 million years. (auth)

28146 COMPARATIVE ANALYSIS OF EFFORTS IN DIFFERENT METHODS FOR CALCULATING L, B-COORDINATES. Getselev, I. V.; El'tekov, V. A.; Volga, V. I.; Kuznetsov, V. A. Kosm. Luchi; No. 13, 213-215(1972). (In Russian).

Due to considerable difficulties of calculating L, B-coordinates several simplified methods are now employed. The relative errors in L, B-coordinates calculated by approximate methods are given. It is suggested to use different methods to calculate L, B-coordinates while solving various problems. (auth)

28147 GEOMAGNETIC FIELD, COSMIC RADIATION, AND CONCENTRATION OF RADIOCARBON IN THE EARTH'S ATMOSPHERE. Dergachev, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1181-1185(Jun 1973). (In Russian).

Examination of the curve of the change of the geomagnetic dipole moment of the Earth led to the conclusion that the period of the change is ~7 to 8 thousand years. The comparison of the experimental data on the concentration of ^{14}C in dated samples with the calculated data indicated that between the variations of the radiocarbon concentration and the changes of the Earth's magnetic moment a reasonably good correlation was observed up to 6,000 years from the present. The scale of inversion of the geomagnetic field is given. Calculations were made of the change of the concentration of ^{14}C in the Earth's atmosphere with and without consideration of inversion. (JSR)

28148 ASYMMETRY OF THE MAGNETOSPHERE AND THE MIDDAY REDUCTION OF THE ABSORPTION AT THE POLAR CAPS. Smirnov, V. S.; Ostapenko, A. A. (Polar Inst. of Geophysics, Apatity, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1323-1326(Jun 1973). (In Russian).

Analytical calculations were made of the diurnal variation of the geomagnetic threshold. The dependence of the geomagnetic threshold on the invariant latitudes is shown. Experimental and calculated values of the amplitude of the midday reduction were compared. (JSR)

28149 BOUNDARY OF THE REGION OF INTRUSION OF LOW-ENERGY SOLAR PROTONS IN THE POLAR IONOSPHERE. Medvedev, M. Yu. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1318-1322(Jun 1973). (In Russian).

On the basis of the model of the magnetosphere, including in it the field of the circular current of protons with energy from 0.2 to 50 keV, the field of the magnetic break, and the tail current field, the boundary of the region of intrusion of low-energy solar protons (E = 10 MeV) was calculated for the midnight and midday meridians. The performances at values of the parameters corresponding to quiet conditions were calculated. (tr-auth)

28150 STUDY OF THE EXCESS RADIATION AT ALTITUDES OF 200 TO 300 km. Guseva, Z. M.; Konyakhina, S. S.; Kurnosova, L. V.; Logachev, V. I.; Platonov, G. D.; Razorenov, L. A.; Ryabenkov, V. I.; Sinitsina, V. G.; Tyasto, V. A.; Fradkin, M. I.; Fotin, Yu. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 6, 1302-1309(Jun 1973). (In Russian).

As a result of the study of the excess radiation at altitudes of 200 to 300 km values were obtained for the currents of electrons and protons originating out of the upper hemisphere. The current of electrons with energy E > 10 MeV in the equatorial region is $j_e \approx 100\ m^{-2}\ sec^{-1}\ sterad^{-1}$ and at latitudes of 40° the current is $j_e \approx 250$ to $300\ m^{-2}\ sec^{-1}\ sterad^{-1}$. The current of protons with energy $E \gtrsim 400$ MeV in the equatorial region is $j_p \approx 200\ m^{-2}\ sec^{-1}\ sterad^{-1}$ and at a latitude of ~40° the current is $j_p \approx 400\ m^{-2}\ sec^{-1}\ sterad^{-1}$. In the undisturbed period at heights of 200 to 300 km the current of bunches of electrons with density ~500 particles/m^3 does not exceed 1 to $3\ m^{-2}\ sec^{-1}\ sterad^{-1}$. Such a relatively small size of the current indicates the absence of an accelerating mechanism under the condition of undisturbed magnetic environment. For the particles of the excess radiation, the current of electrons coincides with the value of the current of the reflected albedo of electrons measured in the stratosphere. The energy spectrum of the protons of the excess radiation has the same indices as the spectrum of protons in the internal radiation belts. (tr-auth)

28151 RELATIONSHIP BETWEEN GEOMAGNETIC PDP PULSATIONS AND THE MOTION OF PLASMA INHOMOGENEITIES IN THE MAGNETOSPHERE. Kiselev, B. V.; Raspopov, O. M.; Rezhenov, B. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 108-110(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 132-135(1973).

The paper analyzes the behavior of the horizontal component of the geomagnetic field on the basis of magnetograms of equatorial stations during the development of PDP intervals. It was found that PDP pulsations are generated on the forward front of the positive pulse, and the appearance of the pulse maximum lags from station to station as one moves westward. (auth)

28152 MAGNETOSONIC RESONATOR OF Pc2, 3 PULSATIONS IN THE EARTH'S MAGNETOSPHERE. Buldyrev, V. S.; Kovtun, A. A.; Fam Van Chi (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 111-116(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 136-142(1973).

The paper advances the hypothesis that part of the Pc2, 3 micropulsations occurring simultaneously over a large longitude interval arise from propagation of magnetosonic waves in a kind of waveguide formed by the toroidal region of the Alfvén velocity minimum girding the Earth. This hypothesis is substantiated by investigating the linearized equation of magnetohydrodynamics with the aid of the parabolic equation method. Formulas are obtained for the eigenfunctions and natural frequencies of a toroidal resonator for an arbitrary change of the magnetosonic wave velocity in the cross section and along the axis of the waveguide. Calculations using experimental data showed that the spectrum of natural oscillations coincides with the spectrum of Pc2, 3, and the distribution of the field with longitude and other characteristics of the field are consistent with the experimental data. (auth)

28153 POSSIBILITY OF A NONLINEAR TURBULENT DYNAMO. Vaynshteyn, L. L.; Vaynshteyn, S. I. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 123-126(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 149-153(1973).

The article discusses the magnetic field generation problem ("dynamo" problem). If the velocity field is turbulent, in order for generation to take place, the turbulence should be gyrotropic in character. It is shown that such gyrotropicity may arise from the very presence of an inhomogeneous magnetic field and from a certain anisotropy in the velocity distribution. The observed gyrotropicity itself depends on the magnetic field, and therefore the field generation equations are nonlinear. The problem of eigenvalues of the generation equations in a certain model is formulated. It is shown that growing solutions exist, i.e., generation can in fact take place. (auth)

28154 MOVEMENT OF LARGE-SCALE INHOMOGENEITIES IN THE IONOSPHERE. Sergeyenko, N. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 158-159(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 186-187(1973).

The correlations of variations of hourly deviations of the critical frequencies of the F2 layer from the moving median value are discussed. Correlations of $\delta f_0 F_2$ for a series of ionospheric stations for June 1958 during daytime and nighttime hours were used. A list of the stations is given. The linear correlation coefficient was calculated, and its space–time relations $\rho(r)$ were studied. (WDM)

28155 FREQUENCY DISPERSION OF TRANSVERSE ELECTRICAL CONDUCTIVITY OF IONOSPHERIC PLASMA. Vay'yan, L. L.; Zelenii, L. M.; Parshev, V. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 159-161(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 188-189(1973).

Expressions for the components of the electrical conductivity tensor are usually obtained from equations of motion of electrons, ions, and neutral particles by assuming that all the particles of a given kind move at the same average velocity. It is shown that the neutral component is decelerated and is not carried along by oscillations of the charged particles and hence slows down the decrease of the transverse conductivities. However, more detailed estimates show that as the frequency decreases, the role of deceleration diminishes, so that the declining character of the frequency dependence of the conductivities is preserved. (WDM)

28156 ESTIMATE OF THE EFFECT OF PHOTOIONIZATION AND ION MOLECULE REACTIONS ON THE DIFFUSION COEFFICIENT IN THE IONOSPHERE. Biragov, S. B. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 162-163(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 191-192 (1973).

The effect of photoionization and ion-molecule reactions on the diffusion coefficient in a magnetoactive plasma with reference to the ionosphere is discussed. It is emphasized that the interest is in changes in the diffusion coefficient, not in changes in the time and space dependences of the concentration of charged particles. (WDM)

28157 SEASONAL VARIATIONS OF THE EMISSION OF THE UPPER ATMOSPHERE IN THE H_α LINE OF HYDROGEN. Martsvaladze, N. M.; Fishkova, L. M. (Astrophysical Observa-

tory, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 163-165(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 192(1973).

Seasonal variations of normalized intensities obtained during an extended observational period from observations at Abastumani and in the other hemisphere are presented. (WDM)

28158 DAY-TO-DAY VARIABILITY OF QUIET-DAY SOLAR DAILY VARIATIONS AND THE DIRECTION OF THE INTERPLANETARY MAGNETIC FIELD. Afanas'yeva, V. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 165-167(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 193-195(1973).

It is shown that the variability of the forms of S_q variation may be due to a change in the direction of the interplanetary magnetic field. Observations from Tucson, Tenerife, Hermanius, Tbilisi, and Odessa were used. (WDM)

28159 ANALYTICAL MODEL OF A GEOMAGNETIC SURVEY FROM KOSMOS 321. Dolginov, Sh. Sh.; Zhuravleva, N. A.; Pushkov, A. N.; Tyurmina, L. O.; Cherevko, T. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 167-169(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 196-197(1973).

The Kosmos 321 satellite with a cesium magnetometer on board was launched on January 20, 1970 with the following initial parameters: orbit inclination to the equatorial plane ~71°, perigee 280 km, apogee 507 km, period of revolution ~92 min. Measurements of the geomagnetic field magnitude were made every 2 sec of flight using a special graph until March 21, 1970. Spherical harmonic analysis of the survey on Kosmos 321 was performed by the iteration method up to n = 9. (WDM)

28160 CONTACT DISCONTINUITIES IN COSMIC PLASMA. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 1-6(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 3-9(1973).

It is postulated that contact discontinuities of anisotropic magnetohydrodynamics are widely distributed and are an important type of discontinuities in cosmic plasma. Results of analysis of measurements at the boundary of the magnetosphere, in the solar wind, and in the magnetospheric tail are discussed. It is noted that the presence of contact discontinuities should be considered in the discussion of recorrection of the interplanetary and geomagnetic fields, in the formulation of boundary conditions of the flow problem and interpretation of the boundaries of "sectors," and in the study of the topology of the interplanetary field and phenomena in the magnetospheric tail. (auth)

28161 OSCILLATIONS OF THE EARTH'S MAGNETIC TAIL IN THE APPROXIMATION OF QUASI-HYDRODYNAMICS. Yershkovich, A. I.; Mart'yanov, S. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 91-95 (1973).

Translated from Geomagn. Aeron.; 13: No. 1, 110-115(1973).

The paper discusses the oscillations of the Earth's magnetic tail in the model of a plasma cylinder with a free boundary on the basis of Chew–Goldberger–Low equations. A dispersion equation of the oscillations was obtained, and its approximate solution was found, which was compared with results obtained on the basis of single-fluid magnetohydrodynamics with ideal conduction. It is shown that long-period variations of the magnetic field (with a period of several tens to hundreds of minutes) may be a manifestation of natural oscillations of the Earth's magnetic tail. (auth)

28162 POSITION OF THE BOUNDARY OF THE MAGNETOSPHERE, DURING 1963–68. Rudneva, N. M.; Fel'dshteyn, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 96-99(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 116-121(1973).

The position of the boundary of the magnetosphere was studied as a function of the magnetic activity level and solar activity cycle. The statistical and dynamic plasma pressures near the magnetopause were calculated on the basis of the theoretical two-dipole model of the magnetosphere. (auth)

28163 RATE OF DECAY OF THE RING CURRENT AND OF POLAR DISTURBANCES. Shevnin, A. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 100-104(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 122-127(1973).

The rate of decay of the ring current and polar disturbances was studied by using the method of the lower envelope of relations of average hourly values of D_{st}- and AE indexes for periods of the magnetic activity maximum (1957-58) and minimum (1963-64). (auth)

28164 SUPER-ALFVEN DISPLACEMENT OF HYDROMAGNETIC PULSES IN THE RADIATION BELT OF THE EARTH. Gul'yel'mi, A. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 13: No. 1, 105-107(1973).

Translated from Geomagn. Aeron.; 13: No. 1, 128-131(1973).

It is shown that a shaped nonlinear signal moves along the radiation belt at a velocity surpassing the group velocity of a linear wave packet. The effect arises because the reinforcement takes place mainly in the forward part of the pulse, whereas the rear part propagates through the medium with a sharply decreased increment. As a result, the forward front and maximum of the pulse undergo an additional forward displacement. This effect has the same character as the superradiant displacement of a light pulse in a laser. Pearl-type geomagnetic pulsations are analyzed which constitute hydromagnetic pulses excited in the radiation belt. It was found that the effective velocity of pearls in the nonlinear regime is ~1.14 times greater than the velocity of a weak signal. (auth)

28165 RESIDUAL GEOMAGNETIC FIELD FROM THE SATELLITE COSMOS 49. Benkova, N. P.; Dolginov, Sh. Sh.; Simonenko, T. N. (Izmiran, Moscow). J. Geophys. Res.; 78: No. 5, 798-803(10 Feb 1973).

The residual field from Cosmos 49 is presented in chart form. This map displays vast areas (1000 to 4000 km across) of negative and positive ΔT (the T are differences between measured and model fields) that are of the order of a few tens of gammas. The external field does not exert any essential influence on the ΔT distribution. The frequency spectrum of ΔT is similar to that of the model field used for the greater part of the chart, but within the "contrast zones" the ΔT spectrum contains higher harmonics. There is no apparent correlation between the ΔT distribution and near-surface anomalies or the thickness of the magnetoactive layer of the earth's crust. The correlation with heat flow distribution is somewhat more distinct within certain regions. It appears that the greater part of ΔT is due to a poor representation of the main geomagnetic field. However, the authors do not exclude the possibility of intermediate anomalies of inductive origin within the mantle, which could contribute to the higher-frequency part of the ΔT spectrum. (auth)

28166 DIFFERENTIAL ENERGY SPECTRUM OF LOW-ENERGY PROTONS IN THE OUTER REGIONS OF THE RADIATION BELT. Panasyuk, M. I.; Sosnovets, E. N. Kosm. Issled.; 11: No. 3, 436-440(1973). (In Russian).

The differential energy spectrum of low-energy protons in the region $2 < L < 3.5$ obtained from a proton spectrometer on Molniya-1 was examined. The experimental results were obtained in a time of relatively quiet magnetic circumstances in June to August 1970. The registration of the protons was made in the following energy intervals: $130 < E_p < 250$ keV, $250 < E_p < 340$ keV, and $340 < E_p < 420$ keV. It is shown that in the differential proton spectra close to $L \approx 3$ there is a maximum at the energy ~300 keV. With increase of the geomagnetic latitude at L = constant the maximum becomes much narrower during the simultaneous shift of the position of the maximum to the high-energy side. The shift of the maximum to the high-energy side was observed also with decrease of L. Comparison of the differential energy spectra of the protons made by Injun-1, Molniya-1, and 1964-45A at different periods of the cycle of solar activity, showed good agreement. At $L < 2.5$ a rich current of protons with $E_p < 340$ keV was registered. It was assumed that its existence can be explained by the effect of the mechanism of resonance acceleration of the protons, connected with the quasi-periodic fluctuations of the magnetic field at the time of the sub-storm. (tr-auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 27063, 27765, and 27783.

28167 (AD-486648) LIGHT BY AN ELECTRON BEAM. Final Report, October–December 1965. Flynt, W. E.; Attaway, J. D. (Varo, Inc., Garland, Tex.). May 1966. Contract AF33-(615)-3244. 95p. (AFML-TR-66-140). NTIS.

Output radiance from a Salisbury effect device was measured from 0.62 micron to 2.4 microns. The "Salisbury effect" refers to a method of electromagnetic energy generation by the passage of an electron beam over a metallic diffraction grating. Measured output radiance values were on the order of two microwatts/sq cm-steradian, and measured bandwidths ranged from 0.03 to 0.19 micron, although there is evidence that much narrower bandwidths could be obtained with minor modifications. Harmonic as well as fundamental measurements are given, and the various related theories are discussed. (auth) (NTIS)

28168 (AD-760038) INTENSE ELECTRON BEAM GENERATION, TRANSPORT, AND DIAGNOSIS. Final Report, January 1970–June 1971. Putnam, S.; Spence, P.; Benford, J.; Ecker, B.; Stallings, C. (Physics International Co., San Leandro, CA). May 1973. Contract DASA01-70 C-0063. 256p. (PIFR-227/294; DNA-2787-F). NTIS.

Intense electron beam generation, transport, and diagnosis oriented toward the development of technology required for construction of an advanced x-ray source are described. Generation and transport of beams were performed both with and without externally applied magnetic fields; (azimuthal, B (theta), and longitudinal, B (z), magnetic fields were employed). Electron beam and x-ray diagnostics developed or modified for use in this work are described along with theoretical work on diode and beam transport phenomena. (auth)

28169 (FRNC-TH-388) STUDY OF THE CONDITIONS REQUIRED FOR THE AXIAL EXTRACTION OF MULTICHARGED IONS FROM A CONFINED ELECTRON BEAM SOURCE. Ton That, T. (Paris Univ., Orsay (France)). 1972. 110p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

A new type of source (designated: confined electron beam source) was studied. In this source the electrons, themselves, produce the ionization and also serve to confine the ions. The electrons have a very narrow velocity distribution; very few collisions occur in their paths and no 180° reflections; when the ions are extracted, the electrons are simultaneously extracted from the source. In addition, all the fields and potentials possess a symmetry of revolution as well as extraction symmetry. The device is briefly described and the space charge phenomenon in the source is analyzed. This analysis enables the depth of the potential well generated by the electron beam traversing the drift tubes to be determined. The solving of the general equation of motion was effected using the SPACH and IONEL calculation programs. The beam is nonlaminar and its charge density is not constant in the straight sections. In the calculation, the beam cannot be represented by the total number of particles; studies of the distribution of currents necessitate the introduction of the macroparticle concept. (FR)

28170 (LA-tr-73-47) INVESTIGATION OF A PULSED CHARGE EXCHANGE SOURCE OF NEGATIVE HYDROGEN IONS. Dimov, G. I.; Rosliakov, G. V. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Aug 1973. Translated by A. D. Cernicek and T. D. Hayard from IIF-35-73. 26p. Dep. NTIS $3.50.

A modified charge-exchange H^- ion source with a current of up to 54 mA in a pulse 100 μsec in duration and a normalized beam emittance of 0.2×0.025 mrad cm is described here. Results of the investigation of the arc plasma source, multiaperture grid system for extracting protons from the plasma, beam pulse shaping and charge exchange in hydrogen are presented. Protons are extracted with a transverse temperature of ~ 0.25 eV, and a proton current up to 3 A. Up to 92% of the protons pass through a louvered extraction grid behind which their space charge is compensated with electrons. The H^- ion yield from a charge-exchange target reaches 90% of its expected value. Scattering in the charge-exchange target does not contribute appreciably to the angular spread which results primarily from extraction through the louvered grid. (auth)

28171 (NIIEFA-A-154) KINETICS OF PUMPDOWN OF THE TWO CHAMBER SYSTEM WITH THE DIAPHRAGMING COUPLING CHANNEL AT PULSE GAS INLET. Ivandikova, N. A.; Saksaganskii, G. L. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 11p. (In Russian). INIS.

Kinetic pressure equations are obtained for a discharge in vacuum chambers of an ion source during a random form of the time function of the gas flow to the source. The possibility exists for pulsed gas admission to the source during retention of a stable pressure in the discharge chamber in the period of current take-off. (tr-auth)

28172 (ORNL-tr-2720) PRODUCTION OF NEGATIVE ALKALI AND ALKALINE EARTH IONS. Heinicke, E. (Heidelberg Univ. (West Germany)). 1967. Translation by G. D. Alton of a German Thesis. 46p. Dep. NTIS $4.50.

Negative ions of the alkali and alkali earth elements were extracted from the plasma of a Penning discharge. The geometry of the discharge, the plasma properties and the requirements were investigated with axial and radial extraction geometries by optimization of the ion current. Predominantly alkali molecular ions were produced with the axial extraction geometry using neon as the support gas. On the other hand when hydrogen was used as the support gas with the radial extraction geometry ion source, atomic ions were detected predominantly. Negative alkali earth ions were produced as molecular ions and their formation was found to be independent of the support gas used. In addition, the negative atomic ions, Be^- and Mg^-, were detected. The alkali metals were vaporized from an oven into the plasma. Vaporization of the alkali earth metals was accomplished by sublimation of metal rods in the plasma. The negative ion currents, especially with alkali molecular ions, produced in the radial extraction geometry ion source were observed to be a factor of ~ 10 greater than those produced in the axial extraction geometry ion source. Radially extracted ion currents: Li^-, 1.2 μA; H^-: 60 μA; Be^-: 30 nA; BeH^-: 200 nA; Mg^-: 300 nA; MgH^-: 700 nA. Axially extracted ion currents: LiH_2^-: 600 nA; NaH_2^-: 200 nA; KH_2^-: 50 nA. The radial extraction source was employed at the Heidelberg tandem Van de Graaff accelerator and produced a beam current of ~ 100 nA of Li^{+++} for continuous periods of operation up to 25 hours. (auth)

28173 LASERS AND RESONANCE RADIATION OF RELATIVISTIC ATOMS AND NUCLEI. Ispirian, K. A.; Margarian, A. T. (Erevan Inst. of Physics). Phys. Lett.; 44A: No. 5, 377-378 (2 Jul 1973).

It is shown that due to the Doppler effect the interaction of the laser beams with relativistic beams of heavy ions results in production of resonance radiation in the vacuum ultraviolet and x-ray regions. It is proposed to use such interaction for obtaining intensive quasimonochromatic beams of gamma quanta. (auth)

28174 LYMAN X RAYS FROM A HIGHLY STRIPPED NITROGEN BEAM. Moore, C. F.; Braithwaite, W. J.; Matthews, D. L. (Univ. of Texas, Austin). J. Phys., B (London); 6: No. 8, 1592-1593 (Aug 1973).

The Lyman series was observed for the hydrogen-like system of bare nitrogen (+7) plus an electron. The experimental resolution for these x ray lines is about 2 eV. (auth)

28175 FILAMENT SUPPORT STRUCTURE FOR LARGE ELECTRON GUNS. Stapleton, R. E.; Weinbrecht, J. F.; Ferdinand, E. O.; Hayden, J. J. (to United States Atomic Energy Commission). U. S. Patent 3,745,401. 10 Jul 1973. Filed date 15 Feb 1972. 4p.

An electron gun filament support structure in which the electron-emitting filaments are held in place by a plurality of opposing leaf springs is described. In a preferred embodiment, the springs are mounted on a filament tray, with the leaf of each spring extending substantially perpendicularly to the tray. Each leaf has one or more slots in its upper edge. The arms of each slot curve substantially outwardly from the opposing leaf springs, whereby a filament having enlarged end portions inserted in the slots of opposing leaf springs is held firmly in place under tension. Damaged or destroyed filaments may readily be removed and new filaments inserted by pressing opposed leaves toward each other, removing one filament, inserting another, and releasing the springs. (auth)

28176 PERIODIC EXCITATION OF RELATIVISTIC ELECTRON BEAMS. Sprangle, P. A. Ithaca, NY; Cornell Univ. (1973). 117p. University Microfilms Order No. 73-20,179.

Thesis (Ph. D.).

The excitation of a relativistic electron beam by means of both a slow and fast waveguide structure is presented. In both cases the beam is injected into a modified waveguide and interacts with

the modes of the guide in such a way as to lose part of its energy. Some of this energy goes into microwave radiation. The slow and fast wave structure represents two basic mechanisms for producing intense microwave emission from a relativistic electron beam. The power content of present day pulsed relativistic beams may be on the order of 10^{10}W or higher. Hence, conversion of even a small amount of this power into microwave radiation is of considerable practical interest. (JFP)

28177 APPLICATION OF NONEQUILIBRIUM SURFACE IONIZATION TO THE EMISSION OF SECONDARY IONS. Jurela, Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Mass Spectrom. Ion Phys.; 12: No. 1, 33-51(Aug 1973).

The equation given by Dobretsov which describes positive surface ionization in the absence of thermodynamic equilibrium is generalized. The resulting equations are applied to the emission of secondary ions in the process of sputtering of solid targets caused by ion bombardment in the intermediate energy region. Using experimental values of the degree of ionization for fifteen different elements, the mean temperatures of the sputtering centers are computed. The temperatures calculated in this way are higher than Nelson's thermal spike temperatures, which are in agreement with nonequilibrium conditions of a secondary ion emission and the fact that the majority of the secondary emitted ions has energies much higher than thermal ones. The ratio of the mean temperatures of the sputtered centers and the critical temperatures for the first group of elements is less than 0.3 and for the second less than 0.5. The agreement between the temperatures of the sputtering centers, computed from the equations describing the degree of positive and negative surface ionization, and their ratio, confirms the hypothesis that the equations derived for nonequilibrium surface ionization describe satisfactorily the emission of secondary ions in the process of sputtering of solid targets with a beam in the range 10 to 100 keV. (auth)

28178 EFFECT OF OXYGEN ON THE SPUTTERING OF ALUMINIUM TARGETS BOMBARDED WITH ARGON IONS. Bernheim, M.; Slodzian, G. (Univ. Paris-Sud, Orsay, France). J. Mass Spectrom. Ion Phys.; 12: No. 1, 93-99(Aug 1973).

A method is proposed for making the ionic etching more uniform. The idea is to reduce the channeling effects by building either an amorphous or a nonepitaxial compound on the surface while the sputtering is going on. The sputtering of 6.2-keV argon ions on aluminum is studied. It is found that the orientation effects on sputtering are greatly reduced when oxygen is introduced in the neighborhood of an aluminum target. (JFP)

28179 DEFLECTION OF SPUTTERED IONS BY SURFACE CHARGES. Richards, J.; Dalglish, R. L.; Kelly, J. C. (Univ. of New South Wales, Sydney). Radiat. Eff.; 18: No. 3-4, 207-209(1973).

The trajectories of ions sputtered from an insulating surface carrying a surface charge were computed. The results show that yields measured in particular directions can be in serious error as the trajectories of low energy sputtered ions depend critically on surface charge and point of origin of the ion. The distorted yield curves for 1.2 and 10 eV ions leaving a surface with a ten volt surface potential are calculated. (auth)

28180 VACUUM TUBE GENERATING FAST ELECTRON BEAMS HAVING LARGE CROSS SECTIONS. Leboutet, H. (to Thomson CSF). French Patent 2,140,840. 9 Jun 1971. 8p. (In French).

A vacuum tube capable of generating high current homogeneous electron beams having large cross sections is presented. It consists of a sealed metallic enclosure containing at least one very elongated cathode which emits the electron beam, an electrostatic focusing device, and at least one anode. The sealed enclosure is provided with a window. The electrostatic focusing device has a structure such that it also can be used to control the homogeneity of the beam. The electron permeable window is provided with a cooling system. (auth)

28181 METHOD AND EQUIPMENT FOR PRODUCING A BEAM OF NEUTRAL PARTICLES OR MULTICHARGED IONS BY CHARGE EXCHANGE. Geller, R. (to Commissariat a l'Energie Atomique). French Patent 2,132,589. 9 Apr 1971. 13p. (In French).

A procedure is presented for producing a beam of neutral particles or multicharged ions, in which a neutralization process or an electric charge exchange process takes place between the charged particles of an incident beam and matter traversed by that beam. The incident charged particle beam traverses a sensibly homogeneous current of powdered material, the grains of which are of the order of 100 A across. The beam thus traverses a screen. The charged particle flow rate is such that a grain or several atoms of a grain corresponds to each charged particle. (auth)

28182 HIGH INTENSITY PULSED ELECTRON BEAM SYSTEM. Mattsson, A. (Instrument AB Scanditronix, Uppsala). Phys. Scr.; 7: No. 3, 132-134(1973).

The design and performance of a high intensity pulsed electron beam system consisting of a high voltage pulse generator and a continuously evacuated vacuum diode operating at 600 kV is discussed. The emitted peak current is 5.7 kA, the pulse length 25 ns and the calculated dose rate 3.6×10^{14} rad/s. (auth)

28183 PLASMATRON-TYPE ION SOURCE FOR METALLIC ELEMENTS. Shimizu, K.; Kawakatsu, K.; Kanaya, K. (Electrotechnical Lab., Tokyo). Nucl. Instrum. Methods; 111: No. 3, 525-529(1973).

A new plasmatron-type ion source for metallic elements is developed. In this source, a vaporizer oven and an intermediate electrode are combined into one set and arc discharge runs through the space in which the charge material is contained. This structure allows to obtain an intense beam efficiently from metallic elements. The characteristics of the source for both gaseous and solid elements are similar to those of a normal duo-plasmatron operated with gaseous elements. The source can produce ion beams of mA order with good quality from various metallic elements. The charge consumption rate is usually in the order of 10 mg/h. (auth)

Atomic and Molecular Properties

Refer also to abstracts 27855, 28235, and 29564.

28184 (LBL-2080) PRECISION MEASUREMENT OF THE g_j FACTOR OF ^{4}He IN THE 2^3S_1 METASTABLE STATE. Ayguen, E. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 125p. Dep. NTIS $8.25. Thesis.

The objective of the measurements reported was to deduce a more precise value for the ratio $g_j(He,^3S_1)/g_j(H,^2S_{\frac{1}{2}})$ and for the Landé g_j-factor of helium in the 1s2s, $^3S_1$ metastable state. This is done by combining the atomic-beam magnetic resonance measurements of $g_j(He,^3S_1)/g_j(Rb^{85},^2S_{\frac{1}{2}})$ and of $g_j(He,^3S_1)/g_j(Cs^{133},^2S_{\frac{1}{2}})$ with extremely precise, published results by others for $g_j(Rb)/g_j(H)$, $g_j(Cs)/g_j(Rb)$ and $g_j(H)/g_s(e)$. Obtaining over 600 resonances in total, the g_j ratios are found to be $g_j(He,^3S_1)/g_j(Rb^{85},^2S_{\frac{1}{2}}) = 1 - 46.83(30) \times 10^{-6}$, $g_j(He,^3S_1)/g_j(Cs^{133},^2S_{\frac{1}{2}}) = 1 - 151.28(30) \times 10^{-6}$. Combining these with the results given previously the value $g_j(He,^3S_1)/g_j(H,^2S_{\frac{1}{2}}) = 1 - 23.25(30) \times 10^{-6}$ is found, and combining this with the results given previously the value $g_j(He,^3S_1) = -2.002\ 237\ 35(60)$ is found. An outline is given of the theoretical calculation of the Landé g_j-factor for the $^3S_1$ metastable state of helium and a resume of the practical work in Ankara, with a description of the main characteristics of the atomic-beam machine, including the first Stern-Gerlach patterns obtained there. (auth)

28185 NUCLEAR SPIN-LATTICE RELAXATION OF ^{3}He GAS IN THE PRESENCE OF OXYGEN. Karra, J. S.; Longenecker, D. U. (Temple Univ., Philadelphia). Phys. Lett., 44A: No. 5, 301-302(2 Jul 1973).

Nuclear spin-lattice relaxation time of ^{3}He gas was measured as a function of oxygen between 0.25 and 15 at.% at room temperature and at 25 atm pressure by using spin-echo. (auth)

28186 COUPLING CONDITIONS AND LEVEL STRUCTURE OF THE NP^4 CONFIGURATIONS. Chaghtai, M. S. Z.; Rahimullah, K. (Muslim Univ., Aligarh, India). Nuovo Cim., 17A: No. 1, 162-170(1 Sep 1973).

An up-to-date picture of the known p^4-configurations is presented by plotting the reduced energy ϵ against $\Psi = \zeta/(5F_2 + \zeta)$ according to Edlén. p^4-level values of Cl X, Xe III, Ar III, Mn X, Sc XIV, Ti XV, V XVI, and Mo IX need be improved. $F_2-\zeta$ vs. Ψ graphs for the O I and S I sequences show a maximum at about $\Psi = 0.07$. $F_2 < \zeta$ for all spectra for $\Psi > 0.17$. It is concluded that the LS-coupling applies strictly to O I, F II, Ne III, Na IV, Mg V, S I, and Cl II only; to Al VI-S IX in the O I sequence and to Ar III-Sc VI in the S I sequence, the LK-coupling should apply better, and to the rest of the spectra treated here the jK-coupling should be more appropriate. Edlén's 1972 work on the O I sequence gives a very satisfactory fit to the Ψ-ϵ graph. (auth)

28187 SIMPLE PERTURBATION-VARIATIONAL CALCULATION FOR $1s^2$-^{1}S. Killingbeck, J. (Univ. of Hull, Eng.). J. Phys., B (London); 6: No. 8, 1376-1381(Aug 1973).

A simple variational calculation, suggested by work on hydrogen atom multipole polarizabilities, is applied to calculate second-order energy shifts $E_2(1)$ for the $1s^2$ configuration. The results for $1 \geq 3$ are better than some of those given by much more complicated calculations. Certain first-order expectation values are calculated exactly, and provide a sensitive check on the first-order perturbed wave function. (auth)

28188 FIRST-ORDER HARTREE–FOCK EQUATIONS FOR THE NSMS ^1S STATES OF HELIUM-LIKE IONS. Rebelo, I. (Oxford Univ.). J. Phys., B (London); 6: No. 8, 1382-1386(Aug 1973).

The solution of the first-order Hartree–Fock equations for the nsms ^1S states of helium-like ions for the case where the orbitals are constrained to be orthogonal is discussed. It is shown that the zero-order solutions discovered by Rebelo and Sharma (J. Phys. B. Atom. Molec. Phys.; 5: 1286-92(1972)) uniquely determine the first-order solutions. (auth)

28189 STUDIES OF THE QUADRATIC ZEEMAN EFFECT. Part 1. Application of the Sturmian Functions. Edmonds, A. R. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 6: No. 8, 1603-1615(Aug 1973).

The hydrogen atom in a strong magnetic field is represented by means of sturmian functions, which offer a complete basis which is well adapted to describing the distortion induced by the field. Methods of computation of the eigenvalue spectrum using this basis are described, and a critical comparison made with results obtained by use of the incomplete basis of hydrogenic radial functions. A brief account is given of the techniques employed for dealing with the very large matrices appearing in the calculations. (auth)

28190 WAVELENGTHS AND ENERGY LEVELS OF THE SECOND SPECTRUM OF CERIUM (Ce II). Corliss, C. H. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand., A; 77A: No. 4, 419-546(1973).

The second spectrum of cerium (Ce II) was compiled in the wavelength region between 2500 and 24,000 Å. Of the 11,000 lines in the list, about 7500 are now classified as transitions between 192 odd levels and 288 even levels. The odd levels arise from 5 configurations ($4f5d^2$, $4f5d6s$, $4f6s^2$, $4f^26p$, and $4f^3$) and the even levels from 7 configurations ($4f^26s$, $4f^25d$, $4f5d6p$, $4f6s6p$, $5d^3$, $5d^26s$, and $5d6s^2$). The known levels extend up to only 52,000 cm^{-1} although the ionization potential is known to be 35,000 cm^{-1} higher. (auth)

28191 STARK BROADENING OF HIGH n–α LINES OF HYDROGEN. LaSalle, T. R. College Park, MD; Univ. of Maryland (1972). 108p. University Microfilms Order No. 73, 18,252.

Thesis (Ph. D.).

High n–α lines from principal quantum number transitions 11 → 10, 12 → 11, 13 → 12, and 14 → 13 at 52.5, 69.1, 88.7, and 111.8μ respectively, were observed in a large diameter inductive discharge at electron densities between 10^{14} and 10^{15} cm^{-3} and electron temperatures of 0.1 to 0.2 eV. Line profiles were measured with a Czerny-Turner far infrared monochromator and a gallium-doped germanium crystal cooled at 4.2°K in liquid helium. Although the 111.8μ line was not fully resolvable and the 52.5 and 69.1μ lines appeared no wider than the instrumental width, the 88.7μ line was broadened sufficiently to obtain line width estimates. These widths were quite small, even above the Inglis-Teller limit, and the accuracy of the measurements was limited by very low-line-to-continuum ratios (0.07–0.5). Ions and electrons should both contribute significantly to the broadening in this experiment: the ions quasi-statically and the electrons, at these low electron temperatures, through elastic collisions. Measured line widths are consistent with theoretical estimates based on previously calculated elastic impact widths and on estimated quasi-static broadening. (Diss. Abstr. Int., B)

28192 I. PROJECTED G1 WAVEFUNCTIONS FOR He_2. II. LOCALIZED WAVEFUNCTIONS FOR H_2O, OH, AND O. Guberman, S. L. Pasadena, CA; California Inst. of California (1973). 178p. University Microfilms Order No. 73-14,307.

Thesis (Ph. D.).

The low lying excited states of He_2 were examined using projected generalized valence bond wave functions. Two types of interactions are shown to be important in understanding the anomalous maxima and the general shapes of the curves. The interaction between core orbitals on opposite centers is important at small R whereas at large R the dominant interaction is between core and Rydberg orbitals on opposite centers. The latter effect is expressible in terms of the exchange kinetic energy and arises from the repulsion between singlet coupled pairs of orbitals. This is described simply in terms of the shapes of the Rydberg orbitals. The results in general agree favorably with experiment where such comparison can be made. Localized wave functions obtained from applying an external localization criterion to orbitals resulting from the GF method are reported for H_2O, OH, and O. The shapes and angles between the orbitals are described in some detail. It is shown that the resulting GF orbitals change in a chemically reasonable manner as one proceeds from O to OH to H_2O. (Diss. Abstr.)

28193 STARK INDUCED INTENSITY BEATS IN LYMAN-BETA AND LYMAN-ALPHA EMISSION FROM BEAM–FOIL FORMED HYDROGEN ATOMS. Alguard, M. J. Corvallis, OR; Oregon State Univ. (1973). 114p. University Microfilms Order No. 73-21,296.

Thesis (Ph. D.).

Observed intensity fluctuations in the emission of Stark-perturbed Ly-α and Ly-β radiation from beam-foil formed atomic hydrogen are compared with theoretical calculations to yield information on the relative cross sections for creation of a hydrogen atom into the various l-levels for n = 2 and n = 3. It is found that the s-levels are preferentially populated (compared with a statistical distribution) by more than a factor of three at the beam energies which were observed. The theory of quantum beats is found to adequately describe the variation of the intensity pattern with field strength and field orientation. The effects of the fringing field, the Zeeman splittings, and the hyperfine interaction on the observed signal are also studied. (Diss. Abstr.)

28194 PERTURBATION-THEORY CALCULATION OF HIGH-ORDER BOUND-BOUND TRANSITIONS. Choudhury, B. J. (Univ. of Manitoba, Winnipeg). Phys. Lett.; 45A: No. 1, 45-46(27 Aug 1973).

The transition rate for high-order bound-bound transitions in hydrogen was calculated by using the approximate perturbation theory result of Bebb and Gold. It is found that there is a considerable amount of discrepancy between the results of the calculation and those of the exact perturbation theory calculation of Gontier and Trahin. (auth)

28195 EVIDENCE FOR RESONANCE COLLISIONS IN ROTATIONAL ENERGY TRANSFER; RAMAN LINES OF H_2. Keijser, R. A. J.; Lombardi, J. R.; Van Den Hout, K. D.; De Groot, M.; Sanctuary, B. C.; Knaap, H. F. P. (State Univ., Leiden). Phys. Lett.; 45A: No. 1, 3-4(27 Aug 1973).

It was shown that resonance collisions are important in rotational energy transfer by measuring Raman line widths in various ortho-para H_2 mixtures. It is found that the contribution of resonance collisions to the linewidths can exceed 40%. (auth)

28196 STUDY OF π STATES OF H_2^+ IN THE ONE CENTRE APPROACH. Stewart, R. F. (Univ. of Glasgow). Mol. Phys.; 25: No. 6, 1451-1455(Jun 1973).

In a previous note (Stewart, Molec. Phys.; 24:879(1972)) finite-difference methods were used to investigate σ states of H_2^+, notably the ground state, in a one center, united atom approach. It was found that even when a large number of harmonics were employed in the expansion of the wave function it was only possible to approach the exact eigenenergy at smaller values of the internuclear distance R_{ab}, an extrapolation procedure being necessary to give results of high accuracy. However calculations by Cohen (Proc. Camb. Phil. Soc.; 58:130(1962)) and Hoyland (J. Chem. Phys.; 44: 2533(1966)) suggest that for π states the one center method should be capable of giving satisfactory results even at large internuclear distances. For a wide range of R_{ab} finite-difference techniques are used to examine the π_u and π_g states of this ion with expansion lengths of between one and seven terms. (UK)

28197 SEMI-LOCALIZED ORBITALS FOR THE GROUND STATE OF HeH^+. Kelkar, V. K.; Bhalla, K. C.; Khubchandani, P. G. (Bhabha Atomic Research Centre, Bombay). Mol. Phys.; 26: No. 1, 221-224(Jul 1973).

In continuation of the study of the construction of molecular wave functions for a molecule from the molecular orbitals of a simpler molecule (Kelkar et al.; Molec. Phys.; 22:1141 (1972)) it was found that though the use of H_2^+ molecular orbitals for H_2 does give good results even better results can be obtained by using the more general orbitals suggested by Mueller and Eyring (J. Chem. Phys.; 19:1495 and 1498 (1951)). These authors have used the method of semi-localized orbitals for H_2 and HF. There seems to be no reference in the literature to the application of this method to the simplest two-electron heteronuclear molecule, namely, HeH^+. The results obtained by this method for the ground state of HeH^+ are reported. (auth)

28198 POLARIZABILITY OF A PAIR OF HELIUM ATOMS. Buckingham, A. D.; Watts, R. S. (Cambridge Univ., Eng.). Mol. Phys.; 26: No. 1, 7-15(Jul 1973).

The polarizability of a pair of helium atoms is calculated as a function of the internuclear distance R using self-consistent field methods in the presence of finite electric fields, and coupled Hartree-Fock perturbation theory. The polarizability component parallel to the internuclear axis increases and the perpendicular component decreases as R decreases. At short range a reduction in the mean polarizability is found, but this occurs at too short a separation to produce a negative second dielectric virial coefficient. Calculations with larger basis sets and with electron correlation will be needed in the future. (auth)

28199 POLARIZABILITY OF A PAIR OF HYDROGEN ATOMS AT LONG RANGE. Buckingham, A. D.; Martin, P. H.; Watts, R. S.

(Cambridge Univ., Eng.). Chem. Phys. Lett.; 21: No. 1, 186-190 (1 Aug 1973).

The coefficients of R^{-6} and R^{-8} in the long-range expansion of the parallel and perpendicular components of the polarizability of a pair of hydrogen atoms at a separation R were calculated. The results are $A_{\parallel}^{(6)} = 2558.59$, $A_{\perp}^{(6)} = 1268.25$, $A_{\parallel}^{(8)} = 90639.5$ and $A_{\perp}^{(8)} = 22010.3$ au. The values of $A_{\parallel}^{(6)}$ and $A_{\perp}^{(8)}$ are somewhat larger than previous theoretical estimates and much larger than the classical values of 729 and 182.25 au. The terms in R^{-8} arise from distortions associated with the dispersion forces and from the field of the quadrupole moment induced by the field-gradient at each atom. (auth)

28200 VIRTUAL ORBITALS, EXCITATION ENERGIES, AND OSCILLATOR STRENGTHS. Bjornaa, N. (Univ. of Oslo). J. Phys., B (London); 6: No. 8, 1412-1417(Aug 1973).

The method of Huzinaga and Arnau (Phys. Rev. A.; 1: 1285-8 (1970)) for improving virtual orbitals in the Hartree-Fock theory is discussed from different points of view. An application to the calculation of excitation energies and oscillator strengths (f values) for the helium atom is given. The calculated excitation energies are found to be accurate to within 2 to 3%. The agreement of the calculated f values with those obtained by more sophisticated methods is remarkable. (auth)

28201 VIBRATIONAL SPACINGS FOR H_2^+, D_2^+, AND H_2. Bishop, D. M.; Wetmore, R. W. (Univ. of Ottawa, Ont.). Mol. Phys.; 26: No. 1, 145-157(Jul 1973).

New calculations are presented for the vibrational energy level spacings of the electronic ground states of H_2^+ and D_2^+ at the adiabatic level of approximation. A second-order perturbation method is used to find the nonadiabatic corrections to these spacings. The relevance of these results to the discrepancies between the observed and calculated vibrational spacings for H_2 is discussed. (auth)

28202 RELATIVISTIC CORRECTION FACTORS TO THE MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE HYPERFINE INTEGRALS CALCULATED WITH HYDROGEN WAVE FUNCTIONS. Rosen, A.; Lindgren, J. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 8: No. 1-2, 45-51(1973).

Relativistic correction factors to diagonal and off-diagonal magnetic dipole and electric quadrupole hyperfine integrals were calculated for p electrons with values of the principal quantum number n in the range $2 \leq n \leq 10$. The correction factors were evaluated by comparing hyperfine radial integrals obtained from relativistic and nonrelativistic hydrogenic wave functions. Relativistic correction factors to the mean values of r^{-3} for the orbital, spin-dipole and spin terms of the effective magnetic dipole Hamiltonian and to the mean values of r^{-3} for the electric quadrupole Hamiltonian were also calculated. These new n-dependent correction factors are compared with earlier commonly used factors and with correction factors obtained from self-consistent-field (SCF) wave functions. It is found that improvement is obtained for $p_{\frac{1}{2}}$ states using these new factors compared with earlier ones, while no significant improvement is obtained for $p_{\frac{3}{2}}$ states. (auth)

28203 TERM $4f^{6}{}^{7}F$ IN Gd III. Johansson, S.; Litzen, U. (Univ. of Lund, Sweden). Phys. Scr.; 8: No. 1-2, 43-44(1973).

Eight lines of the transition $4f^{6}{}^{7}F - 4f^{6}5d^{7}D$ in the Gd III spectrum were observed in the region 14,000 to 26,000 Å. The measurements have led to the establishment of the first term of the $4f^{6}$ configuration. The position of $4f^{6}{}^{7}F_{1}$ is in good agreement with the recent predictions. (auth)

28204 PERTURBATIONS IN THE SPECTRA OF CO ISOTOPIC MOLECULES. I. Partial Analysis of $e^{3}\Sigma^{-} - A^{1}\Pi$ Perturbations. Rytel, M.; Siwiec, T. (Experimental Physics Lab., Rzeszow, Poland). Acta Phys. Pol.; 44A: No. 1, 67-70 (Jul 1973).

For the purpose of obtaining some of the $e^{3}\Sigma^{-}$ state constants of CO isotopic molecules two perturbations in the v = 0 and v = 2 levels of the $A^{1}\Pi$ state are analyzed. (auth)

28205 MEASUREMENT OF THE POLARIZATION OF THE $4^{3}D - 2^{3}p$ AND $3^{3}p - 2^{3}S$ TRANSITIONS IN HELIUM INDUCED BY ELECTRON BOMBARDMENT, BETWEEN 56 AND 60 eV. Defrance, A.; Vacher, M. (Univ., Rennes, France). Compt. Rend., Ser. A, B; 276: No. 25, 917-920(13 Jun 1973). (In French).

A precise measurement of the variation of the polarization rate of the 4471 A and 3889 A lines of helium was performed. It was shown that the resonant formation and the decomposition of triply-excited negative ions are accompanied by variations in the polarization rates, these variations being different according to the ion obtained and the transition considered. (auth)

28206 INTERMOLECULAR POTENTIALS OF SYMMETRIC RARE GAS PAIRS FROM ELASTIC DIFFERENTIAL CROSS SECTION MEASUREMENTS. Farrar, J. M.; Schafer, T. P.; Lee, Y. T. (Univ. of Chicago). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 11, 279-295(1973).

From international centennial Boltzmann seminar; Providence, RI (22 Jan 1973).

The results of low energy crossed molecular beam experiments to determine differential elastic scattering cross sections over a wide angular range for symmetric rare gas pairs are presented. The scattering data are interpreted by finding parameters for a piecewise analytic potential form which is constrained to agree with semiempirical calculations of long range force constants. The validity of determining potentials from rainbow extrema locations and relative amplitudes as well as wide angle scattering is discussed, and the restrictions imposed by the quantization of orbital angular momentum are also mentioned. The utility of second virial coefficient calculations is discussed. A discussion of reduced potential forms for the various systems suggests that a common form does not exist: the validity of a simple, universally valid combination rule is also questioned. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 28418 and 28720.

28207 (LBL-2104) SOLID STATE PHYSICS. Crowe, K. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 20p. (CONF-730642-9). Dep. NTIS $3.00.

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A review of μ^{+} precession experiments is presented. The behavior of the spin of the muon as it interacts in different solids and liquids is discussed, as is muonium formation, "fast" depolarization, and slower relaxation solids and solutions with various chemical and magnetic ions. The interpretation of muonium hyperfine spectra in germanium and silicon, as well as the recently observed anomalous μ^{+} precession in silicon, are presented. The use of muons to probe internal magnetic fields in ferromagnets is also reported. (auth)

28208 ELECTRIC FIELD DEPENDENCE OF POSITRONIUM FORMATION IN MOLECULAR SUBSTANCES. Wilkenfeld, J. M. New York; New York Univ. (1973). 234p. University Microfilms Order No. 73-19,985.

Thesis (Ph. D.).

The effects of an applied electrostatic field on the positron lifetime spectra in a homologous series of paraffins and the paraffinic polymer polyethylene were measured. In the presence of a field, the intensity of the longest-lived of the three resolved lifetime components decreases by as much as 50%, with a concomitant rise in the intensities of the two shorter-lived components. At the highest fields reached, ca. 100 to 250 kV/cm or about $\frac{1}{10}$ the breakdown strength of these insulators, the intensities approach asymptotic limits. The theory permits one extract from the data cross sections for scattering, (σ_{sc}), energy loss (σ_{ϵ}), and annihilation of positrons (σ_{a}), in the energy range of ~ 3 eV, and for the formation of Ps (σ_{f}). The cross sections obtained are those for a molecular repeat unit, the (CH_2) group. Observed differences in the respective rates among the compounds in the homologous series are only density dependent, owing to differences in molecular packing efficiencies. The results represent the first determination of these cross sections in condensed matter. To within a factor of two, they have the values (in units of cm^2): $\sigma_{sc} = 2.5 \times 10^{-17}$; $\sigma_{\epsilon} = 4.0 \times 10^{-21}$; $\sigma_{a} = 7.1 \times 10^{-21}$; $\sigma_{f} = 1.2 \times 10^{-20}$. The corresponding scattering and relaxation cross sections for subionization electrons should be very similar in magnitude to and should display the same trends with variations in molecular structure and lattice morphology as positrons. Therefore, this study makes available parameters of importance in understanding quantitatively the responses of insulators to ionizing radiation. (Diss. Abstr.)

28209 BREIT EQUATION ANALYSIS OF RECOIL CORRECTIONS TO MUONIC ATOM ENERGY LEVELS. Friar, J. L. (Brown Univ., Providence); Negele, J. W. Phys. Lett.; 46B: No. 1, 5-7(3 Sep 1973).

Recoil corrections to the binding energy of μ^{-} ^{208}Pb are calculated using the Breit equation with the Breit interaction for a finite nuclear charge distribution. The results disagree with some previous calculations, although they agree with the results of Breit and Brown in the point charge limit. (auth)

28210 SEARCH FOR μ^- TRANSFER FROM He TO A IN GAS AT 620 ATM. Daniel, H.; Pfeiffer, H. J.; Springer, K. (Univ., Munich). Phys. Lett.; 46B: No. 1, 129-130(3 Sep 1973).

The μ^- transfer from He to A in gas at 620 atm was searched for with a 1.5 l target. No transfer was observed. (auth)

28211 REACTION OF POSITRONIUM ATOMS WITH O_2 MOLECULES IN PORES OF SILICA GEL. Mokrushin, A. D.; Tatur, A. O.; Shantarovich, V. P. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 6, 1216-1219 (Jun 1973). (In Russian).

The effect of the dimensions of the pores of silica gel on the type of interaction of positronium with O_2 was investigated and it was shown that the experimental results are explained well on the basis of the model of the reaction proceeding through formation of the excited complex PsO_2^*. An estimation was given of the upper limits of the lifetime of the PsO_2^* complex relative to the decay into Ps and O_2. (tr-auth)

28212 NUCLEAR MONOPOLE POLARIZATION IN MUONIC ^{208}Pb. Galonska, J. E. (Kernforschungsanlage, Juelich, Ger.); Goeke, K.; Faessler, A. Phys. Lett., 45B: No. 5, 414-416 (20 Aug 1973).

Nuclear polarization effects due to the presence of a muon in an atomic orbit are described in a self-consistent way. Within this framework the monopole part of the polarization energy is calculated by solving Hartree–Fock equations for the combined muon-nucleus system. The nuclear part is described by using the density dependent forces of both Skyrme and Moszkowski. The muon is assumed for the present to be in the 1s and 2s state, respectively, and is treated relativistically. The monopole part of the energy gain turns out to be -0.943 ± 0.070 keV for the 1s-muon and -0.169 ± 0.070 keV for the 2s-muon. The rms-charge-radii are decreasing by 0.20% and 0.036%, respectively. (auth)

Collision Phenomena

Refer also to abstract 28394.

28213 (AD-756217) CROSS SECTION FOR PHOTOIONIZATION OF EXCITED CESIUM ATOMS. Technical Report No. 4 (Final), 1 March 1969-31 October 1972. Nygaard, K. J. (Missouri Univ., Rolla. Dept. of Physics). 31 Dec 1972. Contract N00014-69-C-0271. 94p. NTIS.

The cross section for photoionization of excited cesium atoms was measured in a triple crossed-beam experiment, i.e., two light beams crossing a beam of cesium atoms. The beam of exciting radiation was produced by a GaAs laser or by a cesium hollow cathode discharge lamp. The beam of ionizing radiation was produced by a 250 watt mercury arc lamp and dispersed by a ⅓ meter monochromator. The results show that the cross section as a function photon energy decreases faster than in the recombination measurements of Mohler and Boeckner. Also separate articles on GaAs lasers, cesium masers, laser plasmas, and electron impact ionization, all related to the major photoionization, all related to the major photoionization program are included. (auth)

28214 (AD-761876) ELECTRON SCATTERING FROM A TUNGSTEN (100) CRYSTAL. Edwards, D. E. Jr. (Illinois Univ., Urbana. Coordinated Science Lab.). May 1972. Contract DAAB07-67-C-0199. 185p. (R-556; UILU-ENG-72-2217). NTIS.

The elastic reflection coefficient for the specularly scattered electrons (the (0,0) diffraction beam) was measured for electrons scattered from the (100) surface of a tungsten crystal. The measurements were made at a polar angle of 53 degrees and azimuthal angles of 0 degrees, 22.5 degrees, and 45 degrees. The measurements were made on both clean and gas covered surfaces. The secondary electron energy distribution was also measured at the above angles for clean and gas-covered surfaces. Both loss peaks and secondary peaks were observed. A model is discussed which provides one explanation for the experimentally observed correlation of peaks in the elastic reflection coefficient with peaks in the secondary electron energy distribution. A comparison of model predictions and experimental results is made. (auth)

28215 (BNWL-1751(Pt.2), pp 103-104) ELECTRON-EMISSION CROSS SECTIONS. Toburen, L. H. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

The K-shell ionization of carbon and L-shell ionization of argon was measured for incident alpha particles and deuterons with energies of 0.15 to 0.5 MeV/amu. The Auger electron spectra and ionization cross sections were studied. It was found that a greater amount of multiple ionization occurred for incident alpha particles. (JFP)

28216 (BNWL-1751(Pt.2), pp 104-105) EFFECT OF MOLECULAR BINDING ON PRIMARY IONIZATION. Wilson, W. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Cross sections and angular distributions for electron emission from methane, ethane, ethylene, acetylene, and benzene are compared with those for a molecular hydrogen target for proton impact. A stronger final state interaction is suggested for hydrocarbon molecules. It is not clear what roles autoionization or final state interactions play in producing the more isotropic angular distributions of emitted electrons from hydrocarbon molecules. (JFP)

28217 (CEA-N-1597) THEORETICAL AND EXPERIMENTAL DETERMINATION OF ABSOLUTE IONIZATION CROSS SECTIONS FOR ALKALI METALS BOMBARDED WITH ELECTRONS IN THE 100 TO 2000 eV ENERGY RANGE. Jalin, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 107p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis. Submitted to Paris Univ., Orsay (France).

The absolute electron impact cross sections were measured for alkali metals in the 100 to 2000 eV energy range using a nonmodulated crossed beam technique. All the possible sources of error were carefully analyzed and the corresponding magnitudes estimated. The partial ionization cross sections for singly and multiply charged ions were determined using a mass spectrometer coupled to the absolute cross section measuring equipment. For the case of singly charged ions, the variation of the cross section as a function of the energy of the ionizing electrons is in agreement with the law concerning the permitted optical transitions: $Q = A\log BE/E$. Original calculations of the ionization cross section for Li and Na were effected in the framework of the Born–Bethe approximation with improvements by Gaudin and Botter, to take into account collisions in which the incident electrons are scattered with a large variation in momentum. The values calculated are in excellent agreement with the experimental results obtained and with the theoretical values obtained using other methods. (auth)

28218 (CEA-R-4460) ELECTRON-NEUTRAL ATOM INTERACTION AT LOW ENERGY IN AN ELECTROMAGNETIC FIELD. Fabre, B. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Sep 1973. 82p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis. Submitted to Paris Univ. (France).

The electron-neutral interactions take place in the ionization phase of a gas by laser radiation. The domain of this study–low electron energy and eventually strong electromagnetic field–is new and thus requires original solutions. That is due essentially to the nonvalidity of the Born approximation and of the perturbation method. With proved methods (S matrix), it is possible to calculate transition probabilities when the state of the system is known. The electron-neutral interaction is described by a simple potential which is complete in the adiabatic approximation. All other methods–closed coupling, polarized orbitals–give only approximations to this potential. Numerical tests show the validity of this potential at low energy: calculation of the negative hydrogen ion energy and of the phase shifts in elastic scattering. The wave function of the incident electron can be separated into two parts: one, of infinite extension represents a free pseudo-state, the other which is of finite extent represents a bound pseudo-state. Different methods of solving the SCHRÖDINGER equation are reviewed including both a vector and a scalar potential. Unitary transformations seem interesting because they account for some part of the radiation electron coupling, for the remainder one can use, within given conditions, the perturbation method. Presently, only for weak field or high energies, it is possible to determine the state of an electron–neutral atom system in a field. (auth)

28219 (COO-3283-6) EVIDENCE FOR DOUBLY CHARGED NEGATIVE FLUORINE IONS FROM ELECTRON BOMBARDMENT OF CF_3Cl. Ahnell, J. E.; Koski, W. S. (Johns Hopkins Univ., Baltimore, MD. Dept. of Chemistry). 1973. Contract AT(11-1)-3283. 5p. Dep. NTIS $3.00.

A typical negative ion mass spectrum using 100-eV electrons to bombard CF_3Cl is shown. The peak corresponding to mass 9.5 is clearly evident and is attributed to F^{2-}. The results indicate that the F^{2-} ion must be formed in an excited state by some indirect process in which a singly charged negative ion reacts with either the parent molecule or some fragment of it. (JFP)

28220 (ITEF-910) ROLE OF TWO-PHOTON EXCHANGE IN THE LARGE ANGLE SCATTERING OF HIGH-ENERGY ELEC-

TRONS ON ^{3}He AND ^{4}He NUCLEI. Boytsov, V. N.; Kondratyuk, L. A.; Kopeliovich, V. B. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1972. 17p. INIS.

The two-photon exchange contribution to the scattering of high energy electrons on ^{3}He and ^{4}He nuclei is evaluated in the framework of the potential multiple scattering theory. It is shown that near minimum of the charge form factor, two-photon exchange correction in the elastic cross section is about 30 to 40% and this correction must be taken into account in the analysis of the experimental data for separation the nuclear structure effects at distances which are small as compared with the size of the nucleus. (auth)

28221 (LBL-1839) SEMICLASSICAL METHODS IN REACTIVE AND NONREACTIVE COLLISIONS. Miller, W. H. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 32p. (CONF-730709-4). Dep. NTIS $3.75.

From 8th international conference on the physics of electronic and atomic collisions; Belgrade, Yugoslavia (16 Jul 1973).

A recently developed semiclassical theory designed primarily for treating molecular collisions which take place on one electronically adiabatic potential energy surface, i.e., all degrees of freedom, internal as well as translation, are heavy particle degrees of freedom is reviewed. The general theoretical results and a few simple examples, classically forbidden phenomena, and electronic transitions between different adiabatic electronic states are discussed. (JFP)

28222 (SLA-73-5497-A) ROLE OF COSTER–KRONIG TRANSITIONS IN THE IONIZATION OF SURFACE ATOMS. DuCharme, A. R.; Gerlach, R. L. (Sandia Labs., Albuquerque, N. Mex.; Varian Associates, Palo Alto, Calif.). 1973. 10p. (CONF-731006-2). Dep. NTIS $3.00.

Since Coster-Kronig transitions for isolated atoms are often characterized by higher transition rates than corresponding Auger emission, it is important to consider the quantitative effect of these transitions on the Auger electron spectroscopy of solid surfaces. It is found that cross sections for the electron impact ionization of L- and M-shells of surface atoms are often substantially augmented by core electron vacancy production due to Coster-Kronig transitions to inner sub-shells. In the case of $L_{2,3}$- shell ionization of adsorbed Cl, the L_1 contribution is calculated to be about 17% of the total at higher energies. The M_1 and $M_{2,3}$ ionizations account for about 25% of the total $M_{4,5}$ ionization cross section above sub-shell thresholds in the case of Ba. Calculated cross sections exhibit good agreement with experimental values for the above elements when the effects of Coster-Kronig transitions are included. It is also shown that Coster–Kronig yields may be determined by combining measured secondary electron currents corresponding to respective sub-shell ionizations with calculated cross sections. A yield of .21 is thereby obtained for the Cu M_1-shell. (auth)

28223 LANDE G_j VALUES OF 3D AND 5S LEVELS OF ARGON EXCITED BY ELECTRONIC IMPACT. Moskowitz, P. A. (Universite Scientifique et Medicale, Grenoble, France). Phys. Lett.; 44A: No. 5, 351-352(2 Jul 1973).

Alignment of the 3d and 5s levels of argon was achieved by means of electronic impact excitation. Magnetic resonance, optically detected, allowed the determination of the following Landé g_j values: $3d[7/2]_4$, 1.2501 (8); $3d[7/3]_3$, 1.0842 (9); $3d[1/2]_1$, 1.4885 (20); $5s[3/2]_2$, 1.4782 (10). Lifetimes of the above states were extrapolated from the signal widths. (auth)

28224 PHOTON ENERGY DEPENDENCE OF THE DIFFERENTIAL CROSS SECTION FOR ATOMIC-FIELD BREMSSTRAHLUNG. Faulk, J. D.; Quarles, C. A. (Texas Christian Univ., Fort Worth). Phys. Lett.; 44A: No. 5, 317-319(2 Jul 1973).

In a coincidence experiment the absolute fully differential cross section was measured for atomic-field bremsstrahlung over a range of photon energies for electrons of 140 keV incident on gold and aluminum. The results are compared with the available calculations. (auth)

28225 DISSOCIATION OF THE H_2 MOLECULE FOLLOWING ELECTRON IMPACT AND LEADING TO THE OBTENTION OF ATOMIC HYDROGEN IN THE N = 3 LEVELS. Julien, L.; Glass-Maujean, M.; Descoubes, J. P. (Ecole Normale Superieure, Paris). J. Phys., B (London); 6: No. 8, L196-L200(Aug 1973).

The velocity distribution of H(n = 3) atoms produced by electron impact on H_2 was obtained indirectly from the study of anti-crossing signals on the H_α line of atomic hydrogen. Two distinct groups of velocities were detected: slow atoms at 8 and 9 km s^{-1} appear above a threshold at 17.2 eV, fast atoms with a continuous range of velocities between 30 and 40 km s^{-1} above 27 eV. (auth)

28226 MEASUREMENT OF TOTAL CROSS SECTIONS FOR POSITRONS OF ENERGIES 2 TO 400 eV in He, Ne, Ar, and Kr. Canter, K. F.; Coleman, P. G.; Griffith, T. C.; Heyland, G. R. (University Coll., London). J. Phys., B (London); 6: No. 8, L201-L203(Aug 1973).

The total cross sections for positrons in He, Ne, Ar and Kr were measured in the energy range 2 to 400 eV, using a time-of-flight technique. (auth)

28227 (E,2E) EXPERIMENT AS A PROBE FOR ATOMIC STRUCTURE. Furness, J. B.; McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 6: No. 8, L204-L207(Aug 1973).

The 400-eV (e,2e) experiments of Weigold et al (Phys. Rev. Lett.; 30: 475-7 (1973)) on argon are analyzed in the off-shell impulse approximation using Hartree–Fock single particle wave functions. The theory fits the data excellently. It is sensitive to the model used for the single particle wave functions. Spectroscopic factors describing the probability of each of the observed excited states of the Ar II ion consisting of a $3s^{-1}$ configuration are obtained from the analysis. They obey the appropriate sum rule, thus confirming the validity of the theory. (auth)

28228 EQUIVALENCE OF WAVE AND IMPACT PARAMETER BORN EXPANSIONS. Shakeshaft, R. (New York Univ., NY). J. Phys., B (London); 6: No. 8, 1357-1363(Aug 1973).

Transitions which occur in collisions involving two heavy particles and a light particle may be treated in the impact parameter approximation. It is shown that in the limit that the heavy particles become infinitely massive, the Born expansion in the impact parameter treatment is exactly equivalent to the Born expansion in the correct wave treatment. This result has previously been proved for direct transitions and the proof is extended to rearrangement transitions. (auth)

28229 ASYMPTOTIC EXPANSION OF THE WAVEFUNCTION FOR e–H SCATTERING. Hidalgo, M. B.; Nuttall, J.; Stagat, R. W. (Texas A and M Univ., College Station). J. Phys., B (London); 6: No. 8, 1371-1375(Aug 1973).

The asymptotic expansion of the J = O wave function for electron–hydrogen atom scattering which contains a leading term corresponding to an outgoing wave in any two-body channel is given. The coefficients in the expansion are found from a recurrence relation, for the solution of which a computer program has been written. (auth)

28230 POTENTIAL SCATTERING CROSS SECTIONS IN THE SEMICLASSICAL LIMIT. Mount, K. E. (Univ. of Bristol, Eng.). J. Phys., B (London); 6: No. 8, 1397-1411(Aug 1973).

The semiclassical theory of uniform approximations to the cross section for small angle scattering is investigated numerically for various potential models, including the familiar Lennard-Jones interatomic potential. Calculations of the differential cross section using the semiclassical formulae are compared with quantum mechanical calculations to investigate the accuracy and range of validity of the uniform approximations. It is demonstrated that such methods can predict very precisely the shape of the differential cross section over a surprisingly wide range of conditions. (auth)

28231 STUDY OF ORIENTATION TRANSFER BY COLLISIONS OF THE SECOND KIND BETWEEN ^{198}Hg AND ^{199}Hg ATOMS. Saintout, L.; Cheron, B.; Lecler, D. (Univ., Caen, France). Opt. Commun.; 8: No. 1, 63-67(May 1973).

A double resonance experiment is used to detect the collisional transfer of orientation from an optically oriented $^{198}Hg(6^3P_1)$ atom to the hyperfine levels (6^3P_1; F = 1/2, F = 3/2) of a ^{199}Hg atom. The reaction of transfer is assumed to be $^{198}Hg(6^3P_1) + {}^{199}Hg(6^1S_0) \rightarrow {}^{198}Hg(6^1S_0) + {}^{199}Hg(6^3P_1)$. The theory of such a process is summarized, the experimental set-up described, and the double resonance signals compared with those predicted by the theory. (auth)

28232 K X-RAY SPECTRA FROM Si AND SiO_2 AFTER OXYGEN EXCITATION. Moore, C. F.; Olsen, D. K.; McWherter, J.; Richard, P. (Univ. of Texas, Austin). J. Phys. Soc. Jap.; 34: No. 4, 1020-1021(Apr 1973).

A beam of 30-MeV oxygen ions was used to excite silicon atoms in both a silicon crystal and in a silicon dioxide crystal. The resulting K x-ray spectra show marked deviation from one another. (auth)

28233 NUMERICAL ASYMPTOTIC FUNCTIONS IN VARIATIONAL SCATTERING THEORY. Oberoi, R. S.; Nesbet, R. K. (IBM Research Lab., San Jose, CA). J. Comput. Phys.; 12: No. 4, 526-533(Aug 1973).

A procedure for explicitly incorporating the effects of long range potentials in variational trial functions for electron-atom and electron-ion scattering is outlined. The component of the wave function that represents the asymptotic solution consists of two

parts. Outside a certain boundary radius, the asymptotic solutions are generated numerically. The total trial wave function is made everywhere smooth and continuous by matching these asymptotic solutions at the boundary with two fixed analytical linearly independent functions, defined within the radius in each channel. Two choices of the fixed internal functions are considered. The numerical feasibility of this approach is investigated by application to the problem of scattering of electrons from atomic hydrogen in the static exchange approximation and from the positive He ion in the static approximation. (auth)

28234 VARIATIONAL METHODS FOR MANY-BODY PROBLEMS. Tolchin, S. G. New York; New York Univ. (1973). 136p. University Microfilms Order No. 73-19,977.

Thesis (Ph. D.).

The construction and application of nonlinear variational principles as approximation techniques are investigated. In addition to the function of interest, these principles require the introduction of auxiliary trial functions. The exact auxiliary functions satisfy linear equations and may be interpreted as generalized Green functions. The interpretation of these auxiliary functions is most useful in the application of the variational principles. The method is extended to the construction of variational principles for systems of coupled nonlinear equations. As a physical example, the coupled Dyson equations for the electron-phonon problem are discussed. Also, variational principles for the coupled self-consistency problems generated by truncation of the Green function hierarchy at an arbitrary level are presented. These principles require trial estimates of amplitudes which obey coupled systems of linear integral equations. A method which allows a simplification and decoupling of this system is discussed. For the problem of the coupled one- and two-particle Green functions, the decoupling is effected by the introduction of a modified interaction. The variational method is discussed as a systematic approach to the Green function description of low energy electron-atom problems. As a test of the variational principle and of some of the methods for generating inputs, and as a necessary first step in this systematic approach, an application to helium in the Hartree–Fock truncation is presented. The experience gained in studying this problem indicates that the variational approach should provide a viable calculational tool for more complex problems. (Diss. Abstr.)

28235 TWO MODELS INVOLVING EXCITED STATES OF HELIUM: CAVITIES IN LIQUID HELIUM, AND COLLISIONS OF He(2^3S) WITH H_2. Hickman, A. P. Houston, TX; Rice Univ. (1973). 127p. University Microfilms Order No. 73-21,558.

Thesis (Ph. D.).

Two theoretical studies involving excited states of helium were carried out. A model is developed in which excited helium atoms in liquid helium may exist in stable cavities of diameter 10 to 15 Å. A repulsive interaction between the excited atom and the remaining atoms in the ground state is responsible for cavity formation. The equilibrium shape of the cavity is determined by minimizing the total energy, which is the sum of the electronic perturbation due to the surrounding fluid, and the energy required to form the cavity. The calculations indicate that the optical spectra of helium atoms in these cavities are only slightly perturbed, and agreement with observed spectra lends strong support to the cavity picture. Agreement was obtained with the observed emission transitions $2^3P \rightarrow 2^3S$ and $3^{1,3}S \rightarrow 2^{1,3}P$, and also with the absorption $2^3S \rightarrow 2^3P$, at saturated vapor pressure. Recently the change in these spectral lines as the external pressure is increased to 25 atm. was measured. The model is in good agreement with the data for all lines in which the initial state is spherically symmetric. The question of excitation transfer in the liquid is considered. A semiempirical determination of the long range $^2\Sigma_g$ and $^2\Sigma_u$ interaction potentials of He_2 is used to calculate cross sections for excitation transfer in $^3He(2^3S) - {}^3He(1^1S_0)$ collisions. The results indicate that such a mechanism would not inhibit the formation of stable cavities in the liquid. A close-coupling calculation of cross sections for elastic scattering, rotational excitation, and Penning ionization of H_2 by He(2^3S) is given. The real potential surface used was calculated by Cohen. The probability that the He(2^3S) may ionize the H_2 is included by adding to the real potential energy an imaginary part defining the width. The extension of the close-coupling formalism to include a complex potential is developed, and the efficient solution of the coupled equations is discussed. It is found that at energies $E \leq 0.25$ eV, the cross sections for Penning ionization or rotational excitation are small (0 – 10 Å) relative to the elastic cross sections (160 to 190 Å^2). A semiclassical picture of the collision process is developed, in which the width and the nonspherical parts of the potential are treated as perturbations. Even though the total cross sections are dominated by elastic collisions, rotational excitation and Penning ionization occur with high probability for certain trajectories. A modest semiempirical modification of the asymptotic form of Cohen's width is necessary to achieve agreement with existing data. (Diss. Abstr.)

28236 CROSSED BEAMS MEASUREMENT OF THE TOTAL CHEMIIONIZATION CROSS SECTIONS FOR COLLISIONS BETWEEN HELIUM METASTABLE ATOMS AND VARIOUS STABLE ATOMS AND MOLECULES. Riola, J. P. Houston, TX; Rice Univ. (1973). 140p. University Microfilms Order No. 73-21,591.

Thesis (Ph. D.).

A high vacuum, crossed beams apparatus constructed to study chemiionization is described, and the absolute total ionization cross sections are reported for collisions between He(1s2s $2^{1,3}$S) and Ar, Kr, Xe, CH_4, O_2, N_2, NO, CO, N_2O, and CO_2. Both the experimental and theoretical aspects of previous related work in the field of chemiionization are summarized. The details of the crossed beams system are given, along with the experimental technique involved in measuring the cross sections, the data analysis procedure, the measured results on the crossed beams system, and the checks made for systematic error. The cross sections determined in this study are compared with other published values and possible explanations of the discrepancies are offered. (Diss. Abstr.)

28237 MEASUREMENTS OF CHEMIIONIZATION CROSS SECTIONS FOR He(2^1S,2^3S) – H_2 AND He(2^1S,2_3S) – H COLLISIONS. Howard, J. S. Houston, TX; Rice Univ. (1973). 106p. University Microfilms Order No. 73-21,562.

Thesis (Ph. D.).

Chemiionization cross sections for He(2^1S,2^3S) – H_2 and He (2^1S,2^3S) – H collisions were experimentally determined using a high vacuum crossed-beam apparatus. The experimental procedure and resulting cross section values for total ion production and production of particular ion species are presented, and a detailed analysis of the possible sources of error associated with the measurements is presented. Values obtained with the crossed-beam apparatus are compared with previous experimental results and with recent theoretical calculations. (Diss. Abstr.)

28238 ELECTRON–ALKALI ATOM SCATTERING WITH SPIN ANALYSIS. Kasdan, A. New York; New York Univ. (1973). 155p. University Microfilms Order No. 73-19,937.

Thesis (Ph. D.).

Absolute measurements were made of the total cross section for electron-lithium atom, electron-sodium atom and electron-potassium atom scattering in the energy range 0.5 to 10 eV using a crossed beam recoil technique. Agreement with recent close-coupling calculations is excellent in the case of sodium and potassium. However, the measured lithium cross sections are higher than the theoretical predictions by ~ 30%. Measurements of the spin-exchange ratio $R(\Theta) = \frac{1}{2}\sigma_{ex}(\Theta)/\sigma(\Theta)$ were also made for electron-sodium atom elastic scattering at several energies as a function of electron scattering angle. The measurement is performed by polarizing and velocity selecting the atom beam before the interaction region, and then spin-analyzing the scattered beam. Again, agreement with close-coupling calculations is quite good. In addition, the total cross section measurements were extended to include the alkali homonuclear molecules – Li_2, Na_2, K_2 in the energy range 0.5 to 10 eV. The molecule cross sections are measured to be 35 to 65% above the atom cross sections. (Diss. Abstr.)

28239 INVESTIGATIONS OF THE X-RAY CONTINUUM FROM THICK ELEMENTAL TARGETS. Rao-Sahib, T. S. Los Angeles; Univ. of Southern California (1973). 213p. University Microfilms Order No. 73-18,838.

Thesis (Ph. D.).

The x-ray continuum from thick elemental targets was investigated using a crystal spectrometer in an electron probe microanalyser. A target is bombarded with a finely focused beam of monoenergetic electrons in the energy range 5 to 50 kV. The x-ray spectrum which is consequently produced consists of continuous radiation together with a series of sharp x-ray lines whose wavelengths are characteristic of the elements in the target. When low concentrations of an element are being measured, the continuum can contribute a significant fraction of the total x-ray intensity. More detail knowledge of the continuum is also needed to improve the accuracy of the correction for fluorescence excitation of characteristic x-rays by the continuum. Intensity measurements were made in the wavelength range 1.128 to 9.671 A with beam energies from 10 to 50 kV. Results have not supported the linear atomic number dependence indicated by the Kulenkampff–Kramers equation. In general, for a fixed E_0 and E_ν, the continuum intensity varies as Z^n where n can vary between 1.18 and 1.38 depending upon Z, E_0 and E_ν. For fixed Z and E_ν the intensity varies approximately as $(E_0 - E_\nu)$. The measurements have also indicated the possibility of estimating rel-

ative mass absorption coefficients using the continuum. A new calculation of the intensity was made using the Sommerfeld cross section with the Bethe retardation law. For the cross section an improved version of the empirical formula originally proposed by Kirkpatrick and Wiedmann is used. The intensity thus calculated is in very good agreement with experiment. The theoretical calculations have shown that the mean ionization energy J influences the continuum intensity. Best agreement between theory and experiment is obtained with J = 11.5 Z, although when known inaccuracies in the Sommerfeld cross section are included, the Berger–Seltzer J values are preferable. Duncumb-da Casa J values result in poor agreement. The applicability of commonly accepted correction procedures for characteristic x-rays was verified for the continuum. The backscatter correction was calculated using the formulation by Duncumb and Reed and was found to be different from the backscatter correction for characteristic x-rays. The Andersen and Wittry absorption correction function was used and found to give good results for $f(\chi) \geq 0.4$. Lower values of $f(\chi)$ could not be conclusively tested due to errors caused by stray radiation. The results support a model which assumes that the stray radiation is due to continuous radiation emitted from the instrumentation and caused by electrons backscattered from the specimen. (Diss. Abstr.)

28240 ABSOLUTE CROSS SECTIONS FOR ELECTRON IMPACT EXCITATION OF THE K AND H RESONANCE LINES OF THE Ca^+ ION. Taylor, P. O. Boulder, CO; Univ. of Colorado (1972). 553p. University Microfilms Order No. 73-18,602.

Thesis (Ph. D.).

Crossed beams of electrons and Ca^+ ions were used to measure absolute cross sections for electron impact excitation of the resonance K and H lines of Ca II at 3934 and 3968 Å respectively. Polarization fractions of the light were also measured. The ion beam was produced from a surface ionization source without any significant metastable (D state) contamination. A magnetically constrained electron beam was used to obtain a detailed study of the cross sections and polarization in the low energy region, and the measurements extend to an electron energy of 700 eV. The cross sections presented are absolute in the sense that all measurables, including photon flux, were compared to relevant standards. (Diss. Abstr.)

28241 K SHELL COMPTON SCATTERING ON TIN AND GOLD AT 145 keV AND GOLD AT 320 keV. Wittwer, L. A. Davis, CA; Univ. of California (1972). 66p. University Microfilms Order No. 73-19,117.

Thesis (Ph. D.).

A numerical calculation is given for the inelastic K-shell cross sections of tin with an incident energy of 145 keV and of gold at 145 and 320 keV. The calculation is based on second-order perturbation theory. The bound initial state is the relativistic Hartree–Fock–Slater single particle $1S_{\frac{1}{2}}$ eigenfunction for the particular element concerned. The relativistic scattering solutions are constructed from continuum total spin eigenfunctions for the particular element concerned. The relativistic scattering solutions are constructed from continuum total spin eigenfunctions of the self-consistent potential field of the parent configuration. The necessity of using both negative and positive energy eigenfunctions is demonstrated when using the Dirac relativistic formalism. The calculated spectra are the sum of the Compton line and the infrared divergence with the Compton line being dominant. The Compton line displays the Compton defect and line broadening found at higher incident energies. The Compton line is also almost entirely due to negative energy intermediate state transitions. The infrared divergence, on the other hand, is due entirely to positive energy intermediate state transitions. (Diss. Abstr.)

28242 DIRECT NUMERICAL SOLUTION TO THE CHARGE EXCHANGE EQUATION. Leventhal, L. A. San Diego, CA; Univ. of California (1973). 187p. University Microfilms Order No. 73-18,852.

Thesis (Ph.D.).

In light of the capabilities of modern digital computers, the question of direct numerical solution of the time-dependent Schroedinger equation is raised. It is found that solutions are feasible for the one-electron charge transfer problem. Detailed algorithms are given, and a discussion of the errors committed when reducing quantum-mechanical operators to numerical operators is presented. The equation of a suitable coordinate system for the potentials is shown in the form of contour plots for collisions in one and two dimensions. Results for the proton-hydrogen problem are presented and compared with previous theoretical and experimental work. (Diss. Abstr.)

28243 ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS AT INTERMEDIATE ENERGIES. Callaway, J.; Wooten, J. W. (Louisiana State Univ., Baton Rouge). Phys. Lett.; 45A: No. 2, 85-86(10 Sep 1973).

A variational calculation of electron-hydrogen scattering was performed in the energy range 10 to 30 eV using the Nesbet method. Results are presented for the cross section for elastic scattering. (auth)

28244 PRODUCTION OF MULTIPLY IONIZED STATES OF ARGON IN HEAVY-ION COLLISIONS. Bhalla, C. P. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Phys. Lett.; 45A: No. 2, 123-124(10 Sep 1973).

Recent data on x-rays in the collisions of fully ionized fluorine, nitrogen, and carbon ions of 1.87 MeV/amu with argon are analyzed using Hartree-Fock-Slater calculations. (auth)

28245 PHYSICAL PROCESSES INVOLVED IN GAS IONIZATION. Camplan, J. (CNRS, Orsay, France). Vide; 28: No. 163, 1-8(Jan 1973). (In French).

After a brief review of various ionization processes, special attention was given to ionization by electron impact. Threshold potential absolute and relative ionization cross sections were defined. Surface ionization phenomena were discussed. (auth)

28246 ROLE OF COSTER–KRONIG TRANSITIONS IN MULTIPLY IONIZED STATES FORMED IN HEAVY-ION COLLISIONS. Bhalla, C. P. (FOM Inst. of Atomic and Molecular Physics, Amsterdam); Richard, P. Phys. Lett.; 45A: No. 1, 53-54(27 Aug 1973).

The usually allowed Coster-Kronig $L_1L_{2,3}M$ transitions are found not to be energetically possible for all electronic configurations with a single K-shell and multiple L-shell vacancies of Al. Consideration of these effects as related to x-ray measurements in heavy-ion-atom collisions is presented. (auth)

28247 OBSERVATION OF PLASMON EXCITATIONS IN X-RAY PRODUCTION FOLLOWING HEAVY-ION BOMBARDMENT. McWherter, J.; Bolger, J. E.; Wolter, H. H.; Olsen, D. K.; Moore, C. F. (Univ. of Texas, Austin). Phys. Lett.; 45A: No. 1, 57-58(27 Aug 1973).

Four equidistant peaks are observed below the $K\alpha_{1,2}$ line in the x-ray spectra of Na, Al, Si, SiO_2, Ca, Sc and Ti, produced by oxygen bombardment. With much weaker intensity, these lines are also seen in proton excitation. The lines are interpreted to be due to the excitation of one or more volume plasmons in the target material by the $K\alpha_{1,2}$ x-ray decay. (auth)

28248 (e, 2e) REACTION IN MOLECULES: MOMENTUM SPACE WAVE FUNCTION OF H_2. Weigold, E.; Hood, S. T.; McCarthy, I. E.; Teubner, P. J. O. (Flinders Univ. of South Australia, Bedford Park). Phys. Lett., 44A: No. 7, 531-532(13 Aug 1973).

The first data obtained by the (e, 2e) reaction on the momentum distributions and binding energies for electrons in a diatomic molecule, namely H_2, are presented. Calculations using simple two center wave functions show that the reaction probes details in wave functions. (auth)

28249 MULTIPLE SCATTERING OF CHARGED PARTICLES IN A QUANTIZING MAGNETIC FIELD. Andreev, S. P. (Moscow Engineering Physics Inst.). Dokl. Akad. Nauk SSSR; 210: No. 5, 1047-1049(11 Jun 1973). (In Russian).

Multiple scattering of particles in the presence of a strong magnetic field cannot be represented correctly by use of classical concepts. It is necessary to use a quantum, kinetic equation to solve this problem. The stationary problem of electron scattering on atoms of a substance with potential U(r) in a homogeneous constant magnetic field is considered. The electron density matrix in the Wigner representation is determined by a density matrix in coordinate form so that the problem can be solved without depending on selection of the gauge of the magnetic field. The resulting equation is correct for any value H of the magnetic field, and is the quantum analog of the Boltzmann equation usually used to investigate multiple scattering in a substance. (SJR)

28250 THEORY OF VIBRATION-ROTATION EXCITATION OF MOLECULES. Vitlina, R. Z.; Chaplik, A. V. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 2, 458-465(Aug 1973). (In Russian).

The transition of translational energy into rotation and vibration excitation in molecular collisions is considered. A modification of the sudden perturbation method is employed, it being assumed that the transition inducing interaction is not small. In this way it is possible considerably to increase the range of collision velocities for which the transition probability and cross section can be calculated explicitly. The probability for rotational excitation of molecules under the action of a short light pulse is also calculated. (auth)

28251 DEUTERIUM ISOTOPE EFFECT IN ELECTRON IMPACT DESORPTION OF HYDROGEN ON TUNGSTEN. Jelend, W.; Menzel, D. (Technische Univ., Munich). Chem. Phys. Lett.; 21: No. 1, 178-180(1 Aug 1973).

The deuterium isotope effect of electron impact desorption cross sections was measured for two adsorption states of hydrogen on tungsten with widely differing cross sections. The results of these measurements are in good agreement with values calculated according to the theory of this process proposed earlier. (auth)

28252 EXCITATION OF ALKALI ATOMS IN COLLISIONS WITH MOLECULES. Population of the States K(6^2S) and K(5^2P). Kempter, V.; Kuebler, B.; LeBreton, P.; Lorek, J.; Mecklenbrauck, W. (Univ. Freiburg, i. b.). Chem. Phys. Lett.; 21: No. 1, 164-166(1 Aug 1973).

Radiation at 4050 and 6930 Å was observed in collisions of fast potassium atoms with N_2, O_2, CO, NO, CO_2, C_2H_4 and C_6H_6. Emission at both wavelengths is weak compared to that at 7680 Å. The threshold energy for emission at 6930 Å was found to be equal to the excitation energy (3.4 eV) of the state K(6^2S) for N_2 and NO, but higher (5.5 eV) for CO. (auth)

28253 SIMPLE MODIFICATION OF THE GLAUBER COLLISION AMPLITUDE. Yates, A. C. (Indiana Univ., Bloomington). Chem. Phys. Lett.; 21: No. 1, 37-42(1 Aug 1973).

The connection between the Glauber many-particle amplitude function and the generalized Born series is demonstrated. The correspondence suggests the introduction of a mean excitation energy to improve the inclusion of virtual excitations of the target. (auth)

28254 THRESHOLD EXCITATION SPECTRUM OF CARBON MONOXIDE BY ELECTRON IMPACT. Collin, J. E.; Hubin-Franskin, M. J. (Institut de Chimie, Liege). Chem. Phys. Lett.; 21: No. 1, 66-71(1 Aug 1973).

The SF_6^- threshold electron impact excitation spectrum of CO, in the 10 eV region, recorded with an improved resolution, confirms previous results obtained at lower resolution with the help of a deconvolution procedure. (auth)

28255 INTERACTION OF PROTONS AND HYDROGEN ATOMS WITH CO MOLECULES. Afrosimov, V. V.; Leiko, G. A.; Mamaev, Yu. A.; Panov, M. N.; Vuiovich, M. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 65: No. 2, 495-504 (Aug 1973). (In Russian).

The cross sections for the elementary processes of change of charge states of particles in collisions between $\tilde{H}^+$, $\tilde{H}^0$ and CO molecules are measured in the 5 to 50 keV range for the impinging particles. A charge and mass analysis was performed for both the fast hydrogen particles and slow ions produced from the target molecules. The particles which are partners of a single collision act were measured by the coincidence technique. The retarding potential method was employed for studying the energy spectrum of the C^+ and O^+ ions produced as a result of dissociation of CO molecules. It is shown that the main role in slow ion formation is played by elementary processes involving the formation of fast $\tilde{H}^0$ atoms after the collision (ionization processes for $\tilde{H}^0$ — CO and capture processes for $\tilde{H}^+$ — CO). The contribution of processes involving the formation of fast protons (stripping for $\tilde{H}^0$ — CO and ionization for $\tilde{H}^+$ — CO) increases with growth of the energy and at T_0 = 50 keV reaches 50%. The least significant role is played by processes involving the formation of fast negative $\tilde{H}^-$ ions (capture for $\tilde{H}^0$ — CO and double capture for H^+ — CO). The great majority of O^+ ions possesses energies $\epsilon > 1.5$ eV and are formed as a result of dissociation of the $(CO)^+$ and $(CO)^{+2}$ systems from the repulsive states. However, along with the component $\epsilon > 1.5$ eV in the C^+ ion distribution there is a component with lower energies whose role sharply grows with decrease of energy of the incident particles T_0. It is suggested that this might be due to predissociation of the vibrationally excited bound states of $(C + O^+)$ followed by transition to the repulsive state of $(C^+ + O)$ and also by dissociation of the vibrationally excited states of $(C^+ + O)$ due to direct transfer of kinetic energy of the incident particles to nuclei of the target molecules. (auth)

28256 MEASUREMENTS WHICH INDICATE THE EXISTENCE OF A SECOND SHORT-LIVED STATE OF H^{2-}. Peart, B.; Dolder, K. T. (Univ. of Newcastle-upon-Tyne, Eng.). J. Phys., B (London); 6: No. 8, 1497-1502(Aug 1973).

An apparatus is described in which beams of electrons and H^- ions intersect at an angle of 10°. This was used to make a large number of absolute measurements of the detachment cross section of H^- for energies between 12 and 22 eV, with an energy resolution of about 0.25 eV. The existence of a large structure in the detachment cross section reported by Walton et al (J. Phys. B. Atom. Molec. Phys.; 4: 1343-8 (1971)) was confirmed and, in addition, a second resonance was revealed which had an apparent width of order 0.4 eV at an energy 17.2 ± 0.35 eV above the ground state of H^-. (auth)

28257 ANGULAR AND ENERGETIC DISTRIBUTIONS OF SECONDARY ELECTRONS EMITTED BY SOLID TARGETS UNDER IONIC BOMBARDMENT. Colombie, N.; Benazeth, C.; Mischler, J.; Viel, L. (Univ., Toulouse). Radiat. Eff.; 18: No. 3-4, 251-255(1973).

The energy distributions of secondary electrons emitted by targets bombarded with ions in the range 10 to 100 keV are studied. The energy spectra show an intensive peak at 2 eV. Beyond, in the experiments performed on light elements ($Z \leq 30$) an Auger peak is observed relating to the creation of a hole on the first atomic energy level situated below the valence band (KVV, L_{23}VV and M_{23}VV transitions) accompanied by two or three peaks corresponding to excitation of surface plasmons. Energy spectra obtained from phosphorus and sulphur compounds reveal Auger electrons corresponding to L_{23}(P)VV (or L_{23}(S)VV) and L_{23}(P)$M_{IV\text{-}V}$ (Ga) V (or L_{23}(P)$N_{IV\text{-}V}$ (In) V) transitions; moreover peaks due to plasmon excitations and d band excitations can be distinguished. The first results obtained from some alloys (Fe_3Al, AlMg(15%), Cu_2MnAl) show Auger spectra, characteristic of the different elements which compose the alloy. An anisotropy in the energy angular distribution of secondary electrons emitted from copper single crystal is observed. (auth)

28258 ENERGY DISTRIBUTIONS OF PARTICLES SCATTERED BY RANDOM SOLIDS. Firsov, O. B.; Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 18: No. 3-4, 257-261(1973).

An analysis of the energy distributions of scattered particles using the theoretical approach developed previously is performed. Comparison with experiment (30-keV helium ions forward scattering by various targets) shows that the expressions derived agree reasonably well with the experimental distributions observed. (auth)

28259 PHOTON EMISSION FROM LOW-ENERGY ION AND NEUTRAL BOMBARDMENT OF SOLIDS. Tolk, N. H.; Simms, D. L.; Foley, E. B.; White, C. W. (Bell Telephone Labs., Inc., Murray Hill, NJ). Radiat. Eff.; 18: No. 3-4, 221-229(1973).

Low energy heavy particle bombardment of solid surfaces is observed to be accompanied by the emission of infrared, visible and ultraviolet radiation. Line radiation arising from transitions between discrete atomic or molecular levels may be attributed to the decay of sputtered or backscattered excited particles which have escaped the surface. Broad-band continuum radiation which is also observed in low energy heavy particle collisions with surfaces arises from the surface and appears to be a strictly solid state phenomenon. Measurement of collision induced optical radiation constitutes a powerful tool for studies of the fundamental outer-shell electronic processes which result from the interaction of low energy atomic particles with solids. (auth)

28260 PHOTON-EMISSION INDUCED BY IMPACT OF FAST IONS ON METAL SURFACES. Kerkdijk, C. B.; Thomas, E. W. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). Radiat. Eff.; 18: No. 3-4, 241-244(1973).

A study was made of photon-emission induced by impact of H^+ and He^+ ions on gold and nickel metallic surfaces. An energy selected ion beam (3 to 10 keV) is directed onto a metal surface and the emitted light is analyzed by a monochromator (3000 to 6000 Å). The target is located in a vacuum chamber with base pressure of 1×10^{-9} torr, the target is cleaned by heating and by Ar^+-sputtering. Lines from the He-spectrum (3^3D, 4^3D, 5^3D → 2^3P and 3^3P → 2^3S) and H-spectrum (Balmer α, β, γ) are observed for impact of He^+ and H^+ respectively on both targets. No singlet lines of helium were observed and also no line emissions from the target material. The line-shape of the He-lines was studied in detail. The shape can be qualitatively explained by Doppler shifts of emission from projectiles scattered by bi-particle collisions in the surface. The total intensity of the lines increases as a function of beam energy and of incidence angle on the surface. (auth)

28261 SECONDARY EMISSION OF MOLECULAR IONS FROM LIGHT ELEMENT TARGETS. Leleyter, M.; Joyes, P. (Paris Univ., Orsay, France). Radiat. Eff.; 18: No. 1-2, 105-110(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Some experimental results and calculations are presented on ion clusters produced by primary ion bombardment of light element samples (lithium, beryllium, graphite). Alternations according to the parity of the atom number in the clusters are found in their stabilities, ionization potentials and electron affinities: $Li^+_{2n \pm 1}$ and C^-_{n} ions are found more stable than Li^+_{2n} and $C^-_{2n \pm 1}$ ions respectively. On the other hand, stability of Be^+_n decreases

when n increases. These alternating properties are studied with CNDO computations. The results are compared with those of other authors. (auth)

28262 DETAILED BALANCE AS A CHECK ON IMPACT PARAMETER CALCULATIONS. Tai, H. (City Coll., New York); Gerjuoy, E. J. Phys., B (London); 6: No. 8, 1426-1430(Aug 1973).

It is demonstrated numerically that detailed balance indeed is well satisfied in the multi-state impact parameter formulation of proton-hydrogen atom collisions. It is also demonstrated numerically that detailed balance is a much more sensitive test of computational accuracy than is the charge conservation test usually employed in such impact parameter calculations. It is suggested that detailed balance be used as a check on all impact parameter calculations. That even agreement with detailed balance may not be a sufficient test for accuracy of the results is pointed out. (auth)

28263 INTERPRETATION OF RATE CONSTANTS OF ION–MOLECULE REACTIONS IN OXYGEN SYSTEMS. Rebentrost, F. (Technische Univ., Munich). J. Mass Spectrom. Ion Phys.; 11: No. 5, 475-481(Jul 1973).

Existing data on the charge transfer reaction between O^- and O_2 under nonequilibrium kinetic conditions realized in a drift tube experiment are shown to be in quantitative agreement with a theoretical model of endothermic ion-molecule reactions. For $E/p_0 \geq 20$ V cm^{-1} torr^{-1} the bimolecular rate constant obeys the formula $k = 3 \times 10^{-10} \exp[-11{,}000/(0.33T_g + 50\ E/p_0)]$ cm^3 sec^{-1}. (auth)

28264 REACTIONS BETWEEN H_2^+, D_2^+, AND METHANE MOLECULES $CH_n\ D_{4-n}$ (n LESS THAN OR EQUAL TO 4). Abbe, J. C.; Constantin, E. (Centre de Recherches Nucleaires, Strasbourg). J. Mass Spectrom. Ion Phys.; 12: No. 1, 91-92(Aug 1973). (In French).

Charge transfer and ion molecule reactions between H_2^+, D_2^+ and the deuterated methanes are studied at projectile energies of 2 to 100 eV. The mass spectra, the nature of the secondary ions, and the H–D isotope effects are studied. (JFP)

28265 INELASTIC COLLISIONS OF CHARGED PARTICLES WITH HYDROGEN-LIKE ATOMS IN AN INTENSIVE ELECTROMAGNETIC RADIATION FIELD. Perel'man, N. F. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 3, 22-27(1972). (In Russian).

A new mechanism for the excitation of atoms with degenerate spectra of the charged particles in an intensive electromagnetic radiation field was investigated. The occurrence of new channels of inelastic scattering, determined by processes with participation of a determined quantity of photons of external irradiation, was predicted. Each of these scattering channels has its own threshold and energy spectrum of scattered particles. The angular distribution of the scattering depends on the intensity of the irradiation. (tr-auth)

28266 WAVE MECHANICAL EFFECTS RELATED TO THE SCATTERING OF PROTONS, He^+- AND He_2^+-IONS ON NOBLE GASES. Weise, H. P. Berlin; Technische Univ. (1971). 87p. (In German).

Thesis.

The theoretical principles, the apparatus used for the measurements, the elastic scattering of H^+ on Kr and Xe, of He^+ on He, of He^+ on Kr and Xe, the scattering of H_2^+ on Ar and Kr, as well as a composition and a comparison of the results (with 45 references) are described. By the method of crossed beams the differential elastic cross sections of scattering were measured in detail for the system H^+–Kr, H^+–Xe, He^+–He, He^+–Kr, He^+–Xe, H_2^+–Ar, H_2^+–Kr at primary energies between 3 and 100 eV. From the registered angular distributions the well depth parameter, the equilibrium distance, and partially also the course of the potential curve were determined. (GE)

28267 EXPERIMENTAL STUDY OF HELIUM ATOM COLLISIONS IN THE GROUND AND METASTABLE 2^3S STATES. Kalinin, A. P.; Leonas, V. B. (Inst. of Cosmic Research, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 2, 316-318(11 May 1973). (In Russian).

Differential scattering of He (2^3S) on helium is studied with fast beams. The differential cross sections were measured at angles $\theta E = 0.4$ to 20 ev. deg. The beam energy was 600 eV in the laboratory system of coordinates. The flux of scattered particles I (α) is a function of the differential scattering cross section and of other experimental parameters (especially the geometry of the beam and the detector). Charge transfer of He^+ (1^1S) ions in sodium vapor was used to obtain beams of metastable atoms having an energy of 600 eV. The content of 2^3S helium atoms in the beam is estimated at 93%. The use of high energy beam leads to the condition where the detector does not distinguish particles in the ground and excited states. Thus the measured cross sections are of the elastic scattering cross section and the excitation transfer cross section. A log function of the differential scattering cross section $\sigma(\theta)$ is presented as a function of the angle θ. An improvement in the agreement between calculated and measured values is obtained by taking into account the interactions between other excited states of the helium atom. (SJR)

28268 ELECTRON IMPACT EXCITATION OF H AND He^+. 1. 1s → ns transitions. McDowell, M. R. C. (Royal Holloway Coll., London); Morgan, L. A.; Myerscough, V. P. J. Phys., B (London); 6: No. 8, 1435-1451(Aug 1973).

A polarized orbital distorted wave model is used to calculate total and differential cross sections for 1s → ns (n = 2,3,4,5) electron impact induced transitions in H and He^+ from threshold to 20 Ryd. The total cross sections for the 1s → 2s transitions are in good agreement with experiment, but cannot in this model show resonances. The differential cross sections at energies above 100 eV agree closely with those of Geltman and Hidalgo (J. Phys. B. Atom. Molec. Phys.; 4: 1299-307(1971)). The model reduces to the Born-Oppenheimer (z = 0) or CBO I (z = 0) when the polarization and static potentials are omitted. (auth)

28269 ENERGY DISTRIBUTION OF PROTONS WITH PRIMARY ENERGY OF 15 keV BACKSCATTERED FROM A Ni SINGLE CRYSTAL. Eckstein, W.; Schaeffler, H. G.; Verbeek, H. (Max Planck-Institut fuer Plasmaphysik, Garching, Ger.). Radiat. Eff.; 18: No. 3-4, 263-267(1973).

A nickel single crystal was bombarded with 15-keV protons incident in the vicinity of the ⟨110⟩ and ⟨100⟩ directions. The backscattered protons were energy-analyzed with a spherical electrostatic analyser which could be moved around the target. The energy resolution was $E/\Delta E \approx 140$. The surface peak and a very low scattering intensity from the bulk was observed in a channeling experiment. The latter intensity is zero within the experimental error in double alignment. In this case it can be deduced from the width of the surface peak that less than two atomic layers contribute to it. When the angle between a close-packed direction and the incident beam is increased, at first only the scattering intensity from the bulk increases. When a critical angle is exceeded, the surface peak increases as well. At the same time it broadens and shifts to lower energies. In addition, at energies below the surface peak new peaks in the backscattering spectra appear. Computer simulations indicate that backscattering in this energy range is governed to a great extent by multiple collisions. It is thus impossible to attribute to the observed peaks specific depths from which the backscattering occurs. The enhancement and shift of the surface peak is simulated by the calculations. They cannot, however, explain the observed structure in the spectra. (auth)

28270 FREE ELECTRON TRANSITIONS AND LIGHT AMPLIFICATION. Buimistrov, V. M.; Trahtenberg, L. I. Opt. Commun.; 8: No. 4, 289-290(Aug 1973).

A new mechanism of light amplification on free–free electron transitions is considered, and light amplification is shown to be considerable. The amplification coefficient is calculated. (auth)

Atomic Theory

28271 (AD-759188) STATISTICAL THEORY OF ENERGY LEVELS AND RANDOM MATRICES IN PHYSICS. Final Report. Carmeli, M. (Technology, Inc., Dayton, Ohio). Apr 1973. Contract F33615-71-C-1463. 54p. (ARL-73-44). NTIS.

The physical aspects of the statistical theory of the energy levels of complex systems and their relation to the mathematical theory of random matrices are reviewed. (auth)

28272 (IS-3195) EVEN-TEMPERED REPRESENTATIONS OF ATOMIC SELF-CONSISTENT-FIELD WAVEFUNCTIONS. Raffenetti, R. C.; Ruedenberg, K. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 117p. Dep. NTIS $8.00.

The discussion covers even-tempered orbital bases for atoms and molecules, an outline of atomic self-consistent-field wave functions in terms of even-tempered exponential bases, investigation of the basis size for adequacy and accuracy, double zeta-type self-consistent-field calculations, an augmented basis for self-consistent-field calculations, and other atomic properties. (JFP)

28273 (ORNL-TM-4344) RELATIVISTIC HARTREE–FOCK–SLATER EIGENVALUES, RADIAL EXPECTATION VALUES, POTENTIALS AND ELECTRON DISTRIBUTION FUNCTIONS FOR ATOMS, $56 \leq Z \leq 71$. Nestor, C. W. (Oak Ridge National Lab., Tenn.). Sep 1973. 37p. Dep. NTIS $4.00.

Relativistic Hartree–Fock–Slater wave functions for the elements with Z = 56 to Z = 71 were calculated. From these wave functions the eigenvalues, the expectation values of r, 1/r, $1/r^3$,

r^2 and r^4 and r_{max}, the location of the principal maximum in the electron distribution function, for each orbital are presented in tables and graphs. Also an equivalent point charge which would produce the computed total potential and estimates of the energies of the $K\alpha_1$, $K\alpha_2$, $L\alpha_1$ and $L\alpha_2$ x-rays is tabulated, and a total electron distribution function for each atom is plotted. (auth)

28274 RETARDATION IN TWO-ATOM SYSTEMS. Milonni, P. W. (Univ. of Rochester, NY). Opt. Commun.; 8: No. 1, 60-62(May 1973).

The old problem of two identical two-level atoms a fixed distance r apart, one excited at t = 0, the other unexcited, and the field in the vacuum state is considered. One is interested specifically in the higher order retardation effects, which have not previously been discussed. The existence of an unexpected interference term in the probability for atom 1 to be excited which sets in two retardation times after atom 1 begins to decay is shown. (auth)

28275 EVALUATION OF THE PRINCIPAL VALUE INTEGRAL IN THE SCATTERING PROBLEMS. Chang, T. N.; Poe, R. T. (Univ. of California, Riverside). J. Comput. Phys.; 12: No. 4, 557-560(Aug 1973).

The evaluation by a differential equation method of a class of principal value integrals that occur frequently in atomic and molecular physics is discussed. The equivalence of the matrix-element integration method and the differential equation method for scattering conditions is shown. (JFP)

28276 VALIDITY OF THE CORE-POINT-CHARGE APPROXIMATION FOR INNER SUBSHELLS OF ATOMS. Politzer, P.; Daiker, K. C. (Louisiana State Univ., New Orleans). Chem. Phys. Lett.; 20: No. 4, 309-316(15 Jun 1973).

In order to test the validity of approximating the effects of various atomic inner subshells by means of point charges at the nuclei, the electron repulsion and exchange integrals involving these inner electrons and valence electrons were computed for a series of atoms. The point-charge approximation was found to be very poor for the 3s and 3p subshells of the first-row transition elements. (auth)

28277 TWO-STATE ATOMIC SYSTEM WITH STOCHASTIC COUPLING. Auvergne, M.; Pouquet, A. (Observatory, Nice). Physica; 66: No. 2, 409-415(1 Jun 1973).

It is shown that the transitions induced in a two-state quantum system by a time-dependent stochastic coupling leads to mean-population equipartition. The relaxation time is evaluated when the coupling is a Poisson flip-flop process. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

28278 (AD-759971) ELECTROHYDRODYNAMICS (EHD) RESEARCH. Final Report, 1971–1972. Biblarz, O. (Naval Postgraduate School, Monterey, Calif.). 12 Feb 1973. 100p. NTIS.

Further considerations of the slip parameter for unsteady flow are presented. Several important gas/particle combinations are represented and conclusions regarding electrical efficiency are given. Also, a computer study which solves the combined. Laplace/Poisson equations for geometries representing the EHD channel is included. This program is used to predict the effect of voltage scheduling electrodes, and the predictions are checked out experimentally. (NTIS)

28279 CHARGING OF AEROSOL PARTICLES IN THE ONE-DIMENSIONAL EHD FLOW. Ushakov, V. V.; Franchuk, G. M. Magn. Gidrodin.; No. 2, 70-75(1973). (In Russian).

A system of equations describing the motion of ions and aerosol components in the field of corona discharge between two flat parallel electrodes and a one-dimensional incompressible gas flow was solved on the IBM. Graphs were obtained of the variation of the relative charge of the particles and intensity of the electric field in the discharge gap and its dependence on the degree of dustiness and the flow velocity. For particular cases the analytical dependences permitting the calculation of the intensity of the electric field and the relative charge of the particles were obtained. Expressions were obtained for the volt–amp characteristics with consideration of the dustiness of the flow and for the overvoltage of the corona, during which the cutoff of the corona current occurs. (tr-auth)

28280 ELECTROHYDRODYNAMIC RAYLEIGH–TAYLOR INSTABILITIES OF A PLANE CIRCULAR INTERFACE. Mohamed, A. E. M. A. (Air Shams Univ., Cairo); Nayyar, N. K. Nuovo Cim. 16B: No. 2, 285-292(11 Aug 1973).

The electrohydrodynamic Rayleigh–Taylor instability for two dielectric fluids confined in an infinite rigid cylinder and having a circular horizontal interface is investigated. It is found that the vertical electric field has a destabilizing effect for a set of restricted wave numbers satisfying an eigenvalue equation. The special case when one of the two fluids is a perfect conductor is discussed in some detail. A feed-back mechanism has been introduced to control such instabilities. (auth)

28281 STABILITY OF SECOND GRADE RIVLIN–ERICKSEN MAGNETOFLUID FLOW BETWEEN PARALLEL PLANES IN PRESENCE OF A MAGNETIC FIELD. Carlsson, A. J.; Lundgren, E. (Takniska Hoegskolan, Lund, Sweden). Phys. Scr.; 7: No. 4, 177-178(1973).

The stability equations for lineal flows between parallel planes of a second grade Rivlin–Erickson magnetofluid are given. Some numerical results were obtained for the case where the external magnetic field is parallel to the flow direction, and calculations were started for the case where the external magnetic field is perpendicular to the planes. (auth)

28282 STEADY HARTMANN FLOW AND WAVE PROPAGATION IN SECOND GRADE RIVLIN–ERICKSEN MAGNETOFLUIDS. Lundgren, E. J.; Carlsson, A. (Tekniska Hoegskolan, Lund, Sweden). Phys. Scr.; 7: No. 3, 107-116(1973).

Electrically conducting non-newtonian fluid materials, called second grade Rivlin–Ericksen magnetofluids are defined. The class of lineal magnetohydrodynamic flows, which includes Hartmann flow, is introduced and studied. Steady Hartmann flow, is introduced and studied. Steady Hartmann flow is discussed in detail. In the class of lineal magnetohydrodynamic flows there are wave solutions for second grade Rivlin–Ericksen magnetofluids. Effects of the generalized constitutive assumption are examined for some special cases and compared with classical results for perfect and linearly viscous magnetofluids. (auth)

28283 ANISOTROPIC WAVE MOTIONS UNDER UNIFORM MAGNETIC AND CURRENT FIELDS. Debnath, L. (East Carolina Univ., Greenville, NC). Indian J. Pure Appl Math.; 3: No. 2, 179-191(1972).

An investigation is made into anisotropic and axisymmetric wave motions generated by an arbitrary harmonic pressure distribution acting on the free surface of an inviscid, incompressible and electrically conducting fluid in the presence of uniform magnetic and current fields. The problem is formulated as an initial value problem which is then solved by the joint Laplace and the generalized Hankel transforms treatment in conjunction with asymptotic methods. An integral as well as asymptotic solution of the problem related to certain pressure distributions of physical interest is presented. It is shown that the wave motions are anisotropic and dispersive and the anisotropy is entirely due to the inclusion of the magnetohydrodynamic body force. A detailed discussion of the axisymmetric wave motions including the effects of the imposed magnetic and current fields on the flow has been presented. In addition, it is shown that the present method of solution provides an interesting illustration of the applicability of generalized functions in hydromagnetic wave problems. (Indian Sci. Abstr.)

28284 ELECTRIC CONDUCTIVITY AND SUPERCONDUCTIVITY OF SOLID SOLUTIONS OF VANADIUM, NIOBIUM, AND CHROMIUM. Sirota, N. N.; Fedotov, A. K. (Inst. of Solid State Physics and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 7, 613-616(Jul 1973). (In Russian).

The temperature dependence of the specific electric conductivity $\rho(T)$ of solid solutions in the ternary system V–Nb–Cr was studied in the temperature range from 2 to 350°K. It was shown that at temperature lower than 50 to 120°K the function $\rho(T)$ is proportional to the square of the temperature and higher than 200 to 250°K it is linear. A correlation was found between the superconducting parameters of dilute alloys of V–Cr and Nb–Cr and their electric resistance at temperatures higher than the Debye temperature. (tr-auth)

28285 THREE DIMENSIONAL MHD BOUNDARY LAYER IN AN INCOMPRESSIBLE FLUID. Bam-Zelikovich, G. M. Magn. Gidrodin.; No. 2, 3-11(1973). (In Russian).

It was shown that if the projection of the electromagnetic layer in the direction, orthogonal with the lines of flow of the external current, is constant across the boundary layer, then in MHD boundary layer the secondary current does not occur (as in the usual boundary layer) when the lines of flow of the external current appear with geodesic lines of a streamlined surface. For the region of small dimensions in which large forces are in operation, simplified formulas are introduced for the three-dimensional MHD boundary flow, permitting the calculation of the map of the flow to be reduced to integration of equation of two-dimensional boundary layers. Examples of the flow in three-dimensional MHD boundary layers are examined. (tr-auth)

28286 ROTATION OF A CYLINDER IN A CONDUCTING FLUID IN THE AXIAL MAGNETIC FIELD. Kuznetsov, S. E. Magn. Girodin.; No. 2, 12-18(1973). (In Russian).

The stationary rotational motion of a long cylinder in a conducting fluid, due to the application of an axial magnetic and a radial electrical field, was examined. For laminar axial symmetrical flow of the streamlined cylinder of the fluid theoretical dependences were obtained for the calculation of the axial characteristics of the device during its use for the transformation of electrical energy into mechanical. The effect of the axial parameters on the efficiency of the device was determined. (tr-auth)

28287 VISCOUS CONDUCTING FLUID MHD FLOW IN A TRAVELING MAGNETIC FIELD. Tkachenko, V. F. Magn. Gidrodin.; No. 2, 19-24(1973). (In Russian).

The flow of a viscous incompressible conducting fluid, introduced into a traveling magnetic field, was studied. Two problems were solved. In the first the fluid occupies a half space and is under the influence of a magnetic field, being the superposition of a field of constant longitude and traveling with given induction on the boundary of the tangential components. In the second problem the flow in a two-dimensional channel in a field of two-dimensional inductors was investigated. The solution of the nonlinear system of the equations of magnetohydrodynamics, written with reference to the function of the flow, curl of the velocities, and vector potential of the magnetic field, were studied by the method of successive approximations. The method takes into account the specific properties of the problem and is established in the expansion of the solution in a series by harmonic components, multiple of the basic harmonics of the traveling field. For the second problem the principal terms of the expansion were determined for all harmonics. The expressions introduced for the velocity component indicated that the flow of the electroconducting fluid is nonstationary. In the background of the laminar flat parallel flow pulsation of the velocity occurred with frequencies equal to the frequency of the traveling field, according to the size of the proportional ratio of the constant field to the amplitude of the traveling field. For the second problem a zero approximation during zero harmonics gives a profile of the velocity of the laminar flat parallel flow. (tr-auth)

28288 ROTATION OF A CONDUCTING FLUID WITH A FREE SURFACE IN A ROTATING FIELD. Boguslavskii, V. A.; El'kin,

A. I.; Yantovskii, E. I. Magn. Gidrodin.; No. 2, 25-30(1973). (In Russian).

The rotation of a thin layer of an electroconducting fluid, partially filling a channel of circular cross section, placed inside a stator with rotating field, with neglect of the friction on the front of the channel, was investigated. For cases where the velocity of the fluid is much less than the velocity of the field, the dependence of the forms of free surface, velocity profile, and loss in the electroconducting fluid on the size of the rotation field was obtained for turbulent flow with consideration of the transverse boundary effect. Calculation was compared with experiment. (tr-auth)

28289 NUMERICAL STUDY OF THREE-DIMENSIONAL MHD FLOWS PAST BODIES. Kalis, Kh. E.; Tsinober, A. B. Magn. Gidrodin.; No. 2, 35-40(1973). (In Russian).

The following three-dimensional problems were numerically calculated: (1) flow around a cylinder of rectangular cross section and finite length; (2) flow around inhomogeneity of the electroconductivity of the channel wall; and (3) flow around inhomogeneity of the magnetic field. (tr-auth)

28290 CONDUCTING LIQUID METAL JETS IN A MAGNETIC FIELD. Gnatyuk, V. V.; Gnatyuk, T. A.; Dzhaugashtin, K. E. Magn. Gidrodin.; No. 2, 41-48(1973). (In Russian).

The results of the theoretical study of the axial symmetrical jets of incompressible conducting fluids, being propagated in a transverse magnetic field, were reported. The solution of the problem was done in the framework of the theory of boundary layers on the basis of the generalized integral method for three-dimensional flow. The laminar and turbulent jets were examined. It was shown that during application of the field the jets lose symmetry, characteristic for the usual flow; the dimensions of the jet in the direction of the field increases its dimensions in the perpendicular direction. Results of the experimental study of the turbulent liquid metal jets in transverse fields were also reported. The results of the tests agree with the calculations. (tr-auth)

28291 DESTRUCTION OF A FREE LIQUID METAL JET BY AXIAL CURRENT. Gel'fgat, Yu. M.; Ol'shanskii, S. V.; Yavnaist, G. A. Magn. Gidrodin.; No. 2, 49-54(1973). (In Russian).

The data of theoretical and experimental studies of the process of destruction of liquid metal jets under the influence of an electric current transmitted along them were reported. The criteria, characterizing the destruction of the jets with the current, were determined and an evaluation was given of the dimensions reached by these drops. The experimental data obtained satisfactorily agrees with experimental data. (tr-auth)

28292 OSCILLATING MHD FLOWS OF VISCOUS FLUIDS IN FLAT CHANNELS. Pavlov, K. B. Magn. Gidrodin.; No. 2, 61-64(1973). (In Russian).

The gradient and displacement flow of conducting viscous plastic fluids in transverse magnetic fields was examined. In noninductive approximation solutions were constructed in the form of an infinite trigonometric series. (tr-auth)

28293 SOME INTEGRAL MHD CHANNEL CHARACTERISTICS AT FINITE MAGNETIC REYNOLDS NUMBERS. Shishko, A. Ya. Magn. Gidrodin.; No. 2, 65-69(1973). (In Russian).

An approximate solution of the boundary problem, described in the electrodynamic approximation of the fluid flow in MHD channels with sufficiently expanded electrodes at finite magnetic Reynolds numbers, was constructed. An expression was obtained for the total current, flowing through ideal conducting busbars, being closed at $X \to -\infty$, in dependence on the applied voltage, the character of the decrease of the external field of the entire zone between the electrodes, the length of the electrodes, and magnetic Reynolds numbers. An expression was found for the electromagnetic pressure developed in the MHD channel. (tr-auth)

28294 RETAINING LARGE AMOUNTS OF MOLTEN METAL BY MEANS OF A CONTROLLED MAGNETIC FIELD. Gubarev, V. F.; Paslavskii, E. S. Magn. Gidrodin.; No. 2, 105-110(1973). (In Russian).

On the basis of the analysis of a system of the confinement of flat layers of liquid metals evaluations were made of the required energy expenditure. The optimum relations were established for the parameters of the system, corresponding to the least energy loss, in dependence on the thickness of the layer of retained metal. The studies were done on the basis of the equation of hydrodynamic equilibrium in a variable magnetic field and the heat balance equation. Since the examined configurations are instable, interspaced systems for the automatic control of the magnetic field were proposed by the purpose of stabilization. (tr-auth)

28295 MHD WAKE IN A UNIFORM FLOW PAST BODIES IN A LONGITUDINAL MAGNETIC FIELD. Gorbachev, L. P.; Nikitin, N. V.; Potanin, E. P. Magn. Gidrodin.; No. 2, 140-142 (1973). (In Russian).

The flat laminar MHD wake at a large distance from the body flown past was examined when its form can be neglected and the motion can be characterized by integral values. The electric currents were assumed short-circuited. The induction magnetic field was neglected. In the approximation of the boundary layer theory the solution of the linearized systems of equations of MHD was obtained. (tr-auth)

28296 VOLUME FORCES IN A MOLTEN METAL IN A ROTATIONAL SYMMETRIC MAGNETIC FIELD. Kapusta, A. B.; Nosovitskaya, I. B. Magn. Gidrodin.; No. 2, 142-145(1973). (In Russian).

The flat field of electromagnetic volume forces in a conducting fluid, existing in an electromagnetic field, having a rotational symmetry of the second order, was investigated. The three-dimensional distribution of the azimuthal and radial forces was found in the range of value of the relative frequencies 1 to 100. (tr-auth)

28297 EXPERIMENTAL STUDY OF THE ROTATING MHD COUETTE FLOW IN A COPLANAR FIELD. Gurfink, M. M. Magn. Gidrodin.; No. 2, 31-34(1973). (In Russian).

The investigation of the regime of the flow of the electroconducting fluid between coaxial cylinders in coplanar magnetic field was carried out by means of the measurement of the torque. The internal cylinder was rotating and the torque was determined by the angle of rotation of the external cylinder, suspended on three threads. The circular magnetic field was created by transmission of the constant current through the linear cylindrical conductor, installed coaxially with working cylinder. The experiments showed that in the investigated flow the magnetic field does not prevent formation of the known Taylor vortex flow, but tightens it at very large Reynolds number, after which turbulent flow occurs. The experimental data on the transition is satisfactorily approximated by the linear dependence of the critical Reynolds number on the Stuart number, from which follows the existence at large Reynolds number of the critical value of the ratio of the Hartmann and Reynolds numbers $(Na/Re)_{cr}$ = const. = 0.015. During measurement on the turbulent flow regime quantitative data were obtained on the effect of the magnetic field on the friction and it was established that as in rectilinear tubes in longitudinal magnetic fields the ratio Ha/Re is a characteristic parameter, determining the indicator of the step by step dependence of the coefficient of turbulent friction on the Reynolds number. (tr-auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 27941 and 28344.

28298 (SLAC-TRANS-157) FUTURE OF HIGH-ENERGY PHYSICS. Is a Higher-Energy Accelerator Necessary? Markov, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. Translated from JINR-P2-7079. 48p. Dep. NTIS $4.50.

An inquiry is made as to whether the next generation of accelerators, that succeeding the accelerators that are now or have just been put into operation, is needed. Both the traditional-type accelerator in Batavia and the CERN crossed-beam proton accelerator are considered. The discussion reflects both the optimistic and pessimistic views. (JFP)

28299 NEW MASSIVE NUCLEAR PARTICLE. Baruch, J. (Univ. of Leeds, Eng.). New Sci.; 59: No. 861, 488-490(30 Aug 1973).

When the sea level spectrum of cosmic rays with energies greater than 10^{12} eV was examined and the logarithm of the flux intensity plotted against energy, a pronounced and unexpected kink was found instead of the expected straight line. After extensive checks of the apparatus and the calculations to try and account for this phenomena it has now been accepted that the kink is due to the incoming cosmic rays. The most likely explanation is that the effect is due to a new massive particle with between 40 and 70 times the proton mass, a long lifetime of at least 2×10^{-7} second and a small interaction cross section in the atmosphere- about one tenth that of the proton. (UK)

28300 SEARCH FOR QUARKS IN TERRESTRIAL MATTER. Kim, Y. S. (Ohio State Univ., Columbus). Contemp. Phys.; 14: No. 4, 289-318(Jul 1973).

Recent experimental searches for physical quarks stopped in terrestrial matter are reviewed and summarized in sections entitled; some assumed physico-chemical properties of quark matter (spectral properties, chemical properties, range of quarks in matter and some possible nuclear reactions of slow quarks), quark search with Millikan oil-drop devices, quark search with levitation electrometers (diamagnetic levitation electrometers and ferromagnetic levitation electrometers), quark searches with other types of electrometer, and other quark searches in earth-matter (spectroscopy and quark-induced nuclear reactions in earth-matter). (UK)

Electromagnetic

Refer also to abstract 28655.

28301 (COO-1195-257) ANNUAL PROGRESS REPORT. (Illinois Univ., Urbana. Dept. of Physics). Apr 1973. Contract AT(11-1)-1195. 42p. Dep. NTIS $4.25.

Experimental research on strong, electromagnetic, and weak interactions is summarized. A list of publications is included. (JFP)

28302 (DESY-73/19) MEASUREMENT OF THE REACTION $\gamma d \rightarrow \pi^- pp$, AND DETERMINATION OF CROSS SECTIONS FOR THE REACTION $\gamma n \rightarrow \pi^- p$, AT PHOTON ENERGIES BETWEEN 0.2 AND 2.0 GeV. Benz, P.; Braun, O.; Butenschoen, H.; Finger, H.; Gall, D.; Idschok, U.; Kiesling, C.; Knies, G.; Kowalski, H.; Mueller, K.; Nellen, B.; Schiffer, R.; Schlamp, P.; Schnackers, H. J.; Schulz, V.; Soeding, P.; Spitzer, H.; Stiewe, J.; Storim, F.; Weigl, J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1973. 73p. Dep. NTIS (U.S. Sales Only) $5.75.

The reaction $\gamma d \rightarrow \pi^- pp$ was measured in a bubble chamber experiment at DESY with a bremsstrahlung beam of $E(\gamma,max) = 5.5$ GeV. Total and differential cross sections are presented for the energy region from 0.2 to 2.0 GeV. The extraction of cross sections on the neutron is discussed in detail. The impulse approximation and the closure relation, with corrections for the exclusion principle and the Fermi motion effects, as well as the Chew–Low extrapolation technique are applied. Total cross sections and angular distributions for the reaction $\gamma n \rightarrow \pi^- p$, deduced by these methods, are presented. No positive evidence for an isotensor electromagnetic current is found. The results disagree with some of the measurements of radiative pion capture, if detailed balance is assumed to connect the two reactions. (orig.) (GE)

28303 (DESY-73/24) π^+-ELECTROPRODUCTION ON HYDROGEN NEAR THRESHOLD AT FOUR-MOMENTUM TRANSFERS OF 0.2, 0.4, AND 0.6 GeV^2. Brauel, P.; Buesser, F. W.; Canzler, T.; Cords, D.; Dix, W. R.; Felst, R.; Grindhammer, G.; Kollmann, W. D.; Krehbiel, H.; Meyer, J.; Weber, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jun 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

The reaction $e + p \rightarrow e + \pi^+ + n$ was measured near the one pion threshold, detecting the final electron and neutron in coincidence for values of $q^2 = 0.2$, 0.4, and 0.6 GeV^2. The normalized axial vector form factor of the nucleon relative to its value at $q^2 = 0$ was determined from the data within a theoretical framework based on PCAC and current algebra. (orig.) (GE)

28304 (DESY-73/29) TARGET ASYMMETRY FOR NEUTRAL π MESON PHOTOPRODUCTION ON POLARIZED PROTONS AT 4 GeV IN THE FORWARD DIRECTION. Bienlein, H.; Braunschweig, W.; Dinter, H.; Erlewein, W.; Frese, H.; Knuetel, J.; Luebelsmeyer, K.; Mango, S.; Meyer-Wachsmuth, H.; Morehouse, C. C.; Paul, L.; Schmitz, D.; von Dratzig, A. S. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jul 1973. 15p. Dep. NTIS (U.S. Sales Only) $3.00.

The cross section asymmetry of the reaction $\gamma p \rightarrow \pi^0 p$ was measured for positive and negative target polarization at the Deutsches Elektronen-Synchrotron DESY, Hamburg, at a mean photon energy of 4.0 GeV in the four-momentum transfer range $0.2\ (GeV/c)^2 \leq -t \leq 1.1\ (GeV/c)^2$ in steps of approximately $0.08\ (GeV/c)^2$. The π^0-meson and the proton were detected in coincidence. The asymmetry is compatible with zero in the t-range $0.2\ (GeV/c)^2 \leq -t \leq 0.4\ (GeV/c)^2$ and negative in the t-range $/t/ \geq 0.5\ (GeV/c)^2$. (auth)

28305 (EFI-TF-4(72)) POSSIBLE PHYSICAL EXPERIMENTS ON THE ACCELERATOR WITH THE OPPOSITE DIRECTION e^+e^- BEAMS AT THE ENERGY $2 \times$ (50 to 100) GeV. Ioffe, B. L.; Khoze, V. A. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1972. 58p. (In Russian). INIS.

The physical experiments which can be done on the accelerator with opposing direction e^+e^- beams at energies of $2 \times$ (50 to 100) GeV were examined. The possible experiments in the e^-p collisions at the same energy interval were briefly discussed. (tr-auth)

28306 (FRNC-TH-399) $\pi^0 \rightarrow \gamma e^+e^-$ DECAY. Experimental Determination of the Form Factor. Lacombe, A. (Paris Univ., Orsay (France)). 1972. 67p. (In French). Dep. NTIS (U.S. Sales Only) $5.50.

Thesis.

The results of the experimental determination of the slope of the form factor for π^0 in $\pi^0 \rightarrow \gamma e^+e^-$ decay are presented. The K^+ into $\pi^+\pi^0$ decay channel was chosen, this channel being the only one amongst the decays with π^0 production for which a complete kinetic treatment can be effected. The form factor was evaluated using two different methods for analysis. The value obtained ($a = 0.04 \pm 0.13$) is significantly too high in relation to the theoretical values obtained in both the case of the Adler anomaly and calculations using the dispersion relation (less than 0.03). The lack of accuracy is thought to be due to insufficient quantities of data being used. (FR)

28307 ACCURATE MEASUREMENTS OF THE ENERGY DEPENDENCE OF THE PROCESS $e^+ + e^- \rightarrow e^+ + e^-$, IN THE s-RANGE 1.44 TO 9.0 GeV^2. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). Phys. Lett., 45B: No. 5, 510-512(20 Aug 1973).

The analysis of 12827 $e^+ + e^- \rightarrow e^+ + e^-$ events observed in the s-range 1.44–9.0 GeV^2 allows measurement of the energy dependence of the cross-section for the most typical QED process, with ±2% accuracy. Within this limit the data follow QED, with first-order radiative corrections included. (auth)

28308 EVIDENCE FOR LARGE P_t PHENOMENON IN EXTENSIVE AIR SHOWERS. Sakuyama, H. (Meisei Univ., Tokyo). Lett. Nuovo Cim.; 8: No. 3, 193-196(15 Sep 1973).

The main core and the subcore of an extensive air shower were observed in order to know which is the component of the longitudinal development. The size of the shower is 3.0 $(10)^5$, the age parameter is 0.6, the energy of the nuclear active component is 10^{12} ev and that of the electromagnetic component is 30 to 40 GeV. It is concluded that for the large longitudinal moment phenomenon the threshold energy is about 10^{12} eV and the probability increases as the primary energy. (JFP)

28309 LIMITS TO POSSIBLE SCALAR-BOSON MASS AND COUPLING FROM e^+e^- COLLISIONS. Conversi, M.; D'Angelo, S.; Gatto, R.; Paoluzi, L. (Univ., Rome). Phys. Lett.; 46B: No. 2, 269-273(17 Sep 1973).

Measurements of $e^+e^- \rightarrow e^+e^-$ at 2.8 GeV are reported and interpreted in terms of limits for the mass and coupling of a possible scalar boson of the type introduced in recent renormalizable models of weak interactions. In particular, in the Georgi-Glashow scheme of leptons it is found that the scalar boson mass must be larger than 10 GeV for an $m_W = 10$ GeV (m_W mass of the W-boson) and of 6.5 GeV for $m_W = 15$ GeV. Alternatively its coupling is extremely weak. (auth)

28310 TIME-LIKE ELECTROMAGNETIC FORM FACTORS OF THE CHARGED PSEUDOSCALAR MESONS FROM 1.44 TO 9.0 GeV^2. Bernardini, M.; Bolling, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). Phys. Lett.; 46B: No. 2, 261-264 (17 Sep 1973).

The study of 620 hadron pairs produced in the s-range (1.44 – 9.0)GeV^2 has yielded 110 collinear hadronic events. Their identification in terms of π and K mesons allows the determination of the time-like electromagnetic form factors of these pseudoscalar mesons in the above time-like range. The total number of (e^+e^-) events observed in the same experimental conditions is 18,048. (auth)

28311 ELASTIC ELECTRON–PROTON SCATTERING BETWEEN 0.05 AND 0.30 $(GeV/c)^2$. Botterill, D. R. (Daresbury Nuclear Physics Lab., Eng.); Braben, D. W.; Montgomery H. E.; Norton, P. R.; Matone, G.; Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Orsitto, F.; Stefanini, A. Phys. Lett.; 46B: No. 1, 125-128(3 Sep 1973).

Elastic electron proton scattering was used to check the validity of the dipole fit of the proton form factors at momentum transfer between 0.05 and 0.30 $(GeV/c)^2$. The general behavior of the cross sections is in agreement with previous measurements and is close to the dipole predictions but there is the suggestion of some small amplitude deviations. It is speculated that these deviations may be related to similar effects in the proton form factor derived from the ISR pp elastic scattering data via a Chou-Yang model. (auth)

28312 TARGET ASYMMETRY FOR NEUTRAL π MESON PHOTOPRODUCTION ON POLARIZED PROTONS AT 4 GeV IN THE FORWARD DIRECTION. Bienlein, H.; Braunschweig, W.; Dinter, H.; Erlewein, W.; Frese, H.; Jnuetel, J.; Luebelsmeyer, K.; Mango, S.; Meyer-Wachsmuth, H.; Morehouse, C. C.; Paul, L.; Schmitz, D.; Von Dratzig, A. S. (Physikalisches Institut der RWTH, Aachen). Phys. Lett.; 46B: No. 1, 131-134(3 Sep 1973).

The asymmetry $A = (\sigma^+ - \sigma^-)/(\sigma^+ + \sigma^-)$ of the reaction $\gamma p^{\uparrow\downarrow} \rightarrow \pi^0 p$ was measured at the Deutsches Elektronen Synchrotron DESY, Hamburg at a mean photon energy of 4.0 GeV in the four-momentum transfer range 0.2 $(GeV/c)^2 \leq -t \leq 1.1$ $(GeV/c)^2$ in steps of approximately 0.08 $(GeV/c)^2$. The π^0-meson and the proton were detected in coincidence. The asymmetry is compatible with zero in the t-range 0.2 $(GeV/c)^2 \leq -t \leq 0.4$ $(GeV/c)^2$ and negative in the t-range ≥ 0.5 $(GeV/c)^2$. (auth)

28313 ELLIPTIC POLARIZATION OF THE SYNCHROTRON RADIATION OF HIGH-ENERGY ELECTRONS. Bagrov, V. G.; Nikitin, M. M. Sov. J. At. Energy (Engl. Transl.); 31: No. 3, 1005(Sep 1971).

Translated from At. Energ. (USSR); 31: No. 3, 272-273(Sep 1971).

Typical vertical angular distributions of the intensities of N′ and N″ polarization components for an accelerated electron energy of 800 MeV and for various angular positions of the Wollaston prism are shown. The theoretical conclusion that the synchrotron radiation is elliptically polarized for directions $0 < \theta < \pi/2$ for clockwise rotation and for $\pi/2 < \theta < \pi$ for counterclockwise rotation along the ellipse is confirmed. (JFP)

28314 SIGN OF MUON CHARGE ASYMMETRY IN THE REACTION $e^-e^+ \rightarrow \mu^-\mu^+$ AND MODELS OF UNIFIED ELECTROMAGNETIC-WEAK INTERACTION. Lipmanov, E. M.; Mikheev, N. V. (Yaroslav State Univ., USSR). Yadern Fiz.; 18: No. 2, 386-389(Aug 1973). (In Russian).

The hypothesis on existence of neutral axial pseudoelectric lepton current $J^{em}_{5\alpha}$, interacting with a heavy neutral vector boson, assuming the "strong" μe universality, predicts a negative additional (to that predicted by the quantum electrodynamics) charge asymmetry in the muon angular distribution from the reaction $e^-e^+ \rightarrow \mu^-\mu^+$ in the energy region below the boson production threshold in cms. Experimental detection of the (abnormal) charge asymmetry with an opposite sign would be in a sure contradiction with a large class of the unified models of electromagnetic–weak interaction, in which the weak charged (V–A) current and the electromagnetic current are related to the generator of the same group SU(2) ⊗ U(1). (auth)

28315 LIMITS OF THE MASS OF HEAVY LEPTONS. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). Nuovo Cim.; 17A: No. 2, 383-390(21 Sep 1973).

A further search for heavy leptons at the ADONE e^+e^- storage ring has revealed no events. This establishes, with 95% confidence, that, if a heavy lepton exists and is universally coupled only to ordinary leptons, its mass must be heavier than 1.4 GeV. If it is also coupled to the hadrons, its mass must be greater than 1 GeV, again with 95% confidence. (auth)

Weak

Refer also to abstracts 28301, 28502, and 28503.

28316 MUON POLARIZATION IN THE DECAY $K^0_L \rightarrow \pi^-\mu^+\nu_\mu$, AN EXPERIMENTAL TEST OF TIME REVERSAL INVARIANCE. Turner, W. C. New Haven; Yale Univ. (1973). 264p. University Microfilms Order No. 73-19,044.

Thesis (Ph.D.).

The results of a high statistics scintillation counter-electronics experiment measuring the muon polarization in the decay $K^0_L \rightarrow \pi^-\mu^+\nu_\mu$ by the method of spin precession are reported. Within the framework of a vector interaction the result of our measurement for the form factor ratio $\xi(q^2) = f_-(q^2)/f_+(q^2)$ is $Re\xi(0) = -0.385 \pm 0.105 - 6.0\lambda_+$, $\lambda_- = 0.0$, and $Im\xi = -0.060 \pm 0.045$. The principle of time reversal invariance requires that ξ be real and no significant violation was observed. The momentum dependence parameters (λ_+,λ_-) defined by $f_\pm(q^2) = f_\pm(0)\ [1 + \lambda_\pm(q^2/M^2_\pi)]$ are not determined by the analysis. (auth)

28317 HIGH ENERGY ELECTRONIC NEUTRINO (ν_e) AND ANTINEUTRINO ($\bar{\nu}_e$) INTERACTIONS. Eichten, T. (Technische Hochschule, Aachen); Deden, H.; Hasert, F. J. Phys. Lett.; 46B: No. 2, 281-284(17 Sep 1973).

The total cross sections for $\nu_e(\bar{\nu}_e)$-nucleon scattering were measured. A test was made of the muon number conservation law. A limit of 2.4 GeV is found for the mass of the "Georgi-Glashow type" heavy lepton. (auth)

28318 MEASUREMENT OF THE NEUTRINO–NUCLEON AND ANTINEUTRINO–NUCLEON TOTAL CROSS SECTIONS. Eichten, T. (Technische Hochschule, Aachen); Faissner, H.; Hasert, F. J. Phys. Lett.; 46B: No. 2, 274-280(17 Sep 1973).

The ν and $\bar{\nu}$ nucleon total cross sections were determined as a function of energy using a sample 2500 ν and 950 $\bar{\nu}$ event. The results are compared with predictions of scaling and charge symmetry hypotheses. (auth)

28319 SEARCH FOR ELASTIC MUON–NEUTRINO ELECTRON SCATTERING. Hasert, F. J. (Technische Hochschule, Aachen); Faissner, H.; Krenz, W. Phys. Lett.; 46B: No. 1, 121-124(3 Sep 1973).

One possible event of the process $\nu_\mu^- + e^- \rightarrow \nu_\mu^- + e^-$ was observed. The various background processes are discussed, and the event interpreted in terms of the Weinberg theory. The 90% confidence limits on the Weinberg parameter are $0.1 < \sin^2\theta_W < 0.6$. (auth)

28320 OBSERVATION OF NEUTRINO-LIKE INTERACTIONS WITHOUT MUON OR ELECTRON IN THE GARGAMELLE NEUTRINO EXPERIMENT. Hasert, F. J. (Technische Hochschule, Aachen); Kabe, S.; Krenz, W. Phys. Lett.; 46B: No. 1, 138-140(3 Sep 1973).

Events induced by neutral particles and producing hadrons, but no muon or electron, were observed in the CERN neutrino experiment. These events behave as expected if they arise from neutral current induced processes. The rates relative to the corresponding charged current processes are evaluated. (auth)

Strong (Baryon-induced)

Refer also to abstract 28301.

28321 (DESY-73/27) POSSIBILITY TO STUDY PROTON–PROTON INTERACTIONS AT EXTREMELY HIGH ENERGIES. Ting, S. C. C. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jul 1973. 9p. Dep. NTIS (U.S. Sales Only) $3.00.

The possibility of colliding an extracted booster beam with the main accelerator beam from NAL or CERN machines to obtain super high energy proton-proton interactions and the class of interesting experiments that one can do with such a set up are discussed. (orig.) (GE)

28322 (ISN-7314) VECTOR AND TENSOR ANALYZING POWERS IN THE SCATTERING OF 30 MeV POLARIZED DEUTERONS BY PROTONS. Fiore, A.; Nguyen Van Sen; Perrin, G.; Darves-Blanc, R.; Gondrand, J. C.; Mueller, H. (Grenoble Univ. (France). Institut des Sciences Nucleaires). 1973. 6p. Dep. NTIS (U.S. Sales Only) $3.00.

The results of measurement of the deuteron vector and tensor analyzing powers in the H(d,d) scattering at 30 MeV are reported. (auth)

28323 HIGH ENERGY HADRON PHYSICS. Foa, L. (Scuola Normale Superiore, Pisa, Italy). Riv. Nuovo Cim.; 3: No. 3, 283-319(1973).

An outline is given of the new results obtained in the study of two-body, quasi-two-body, and many-body hadron reactions, stressing particularly the energy dependence of the parameters involved. The topics covered include total cross sections, elastic scattering, and many-body production. (LBS)

28324 LARGE ANGLE PRODUCTION OF STABLE PARTICLES HEAVIER THAN THE PROTON AND A SEARCH FOR QUARKS AT THE CERN INTERSECTING STORAGE RINGS. British-Scandinavian Collaboration. Phys. Lett.; 46B: No. 2, 265-268(17 Sep 1973).

Measurements were performed on production of particles with mass >1.5 GeV/c^2 and charge $\geq \frac{2}{3}$ for $\theta_{lab} = 62.5°$ and $\sqrt{s} = 53$ GeV. At $p_T = 0.7$ GeV/c the relative rate of production of antideuterons to π^- is $(5 \pm 1) \times 10^{-4}$. The deuteron to antideuteron ratio is 3.7 ± 1.2. No new stable particle was seen among 0.7×10^8 charged particles entering our detector. (auth)

28325 NEW MEASUREMENT OF THE Λ LIFETIME. Poulard, G.; Givernaud, A.; Borg, A. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 46B: No. 1, 135-137(3 Sep 1973).

A new measurement of the Λ lifetime was performed using three different K^-p experiments in three different hydrogen bubble chambers. The final result based on 36,000 Λ decays leads to a lifetime of $(2.626 \pm 0.020) \times 10^{-10}$s which is definitely larger than the present accepted value of $(2.521 \pm 0.021) \times 10^{-10}$ s. (auth)

28326 ENERGY SPECTRA OF NEUTRONS EMITTED IN THE INTERACTION OF HIGH ENERGY PROTONS WITH SEVERAL ELEMENTS. Skoski, L. New York; New York Univ. (1973). 98p. University Microfilms Order No. 73-21,137.

Thesis (Ph. D.).

The energy spectra of neutrons emitted in high energy proton interactions with various elements was measured. The thin targets of cobalt, aluminum, and carbon were chosen on the basis of their importance in the solutions of many geophysical and astrophysical problems. The experiment was performed in the 90° cave of the Princeton Pennsylvania Accelerator, using the internal 3 GeV proton beam as the incident flux. The secondary neutrons were detected by a liquid scintillator. Neutron energies between 1 and 300 MeV were determined by both time of flight analysis and the analysis of the proton recoil spectra in the scintillator. The experimental results were interpreted in terms of the two-step cascade, evaporation model of the intranuclear cascade. All the spectra exhibited a flattening at the lower energy end. This was especially prevalent for the heaviest elements and decreased with decreasing atomic weight. At the higher energies the slopes became progressively steeper for both increasing energy and increasing atomic weight. The results were compared to a theoretical calculation based on the Monte Carlo method with good to excellent agreement. (Diss. Abstr.)

28327 SHADOW CORRECTIONS WITH ACCOUNT OF INELASTIC SCREENING AND CALCULATION OF TOTAL CROSS SECTIONS FOR pn, $\bar{p}n$, and K^+n COLLISIONS. Anisovich, V. V.; Stoyanova, D. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 2, 447-450(Aug 1973). (In Russian).

Total cross sections for interactions of particles with neutrons in the energy range 25 to 60 GeV are found using the data on the particle total cross sections on protons and deuterons. The obtained total cross sections are in agreement with the relation $\sigma(pp) - \sigma(p,n) = \sigma(K^+p) - \sigma(K^+n)$ predicted in the quark model. (auth)

28328 PROTON–DEUTERON TOTAL REACTION CROSS SECTIONS IN THE ENERGY RANGE (20 TO 50) MeV. Carlson, R. R. (Univ. of Redlands, CA); Doherty, P.; Margaziotis, D. J.; Slaus, I.; Tin, S. Y.; Van Oers, W. T. H. Lett. Nuovo Cim.; 8: No. 5, 319-323(29 Sep 1973).

The pd total reaction cross section was measured in the energy range 20 to 50 MeV using the total reaction cross-section experimental set-up at the UCLA sector focused cyclotron facility. The results are compared with various theoretical calculations based on the Faddeev formalism. (LBS)

28329 ANALYSIS OF REACTIONS $pp \rightarrow NN2\pi$ and $pp \rightarrow NN3\pi$ AT THE INCIDENT PROTON MOMENTUM 19.1 GeV/c. Takibaev, Zh. S.; Boos, E. G.; San'ko, L. A.; Zaitsev, K. G.; Sharapov, K. V. (Inst. of High Energy Physics, Alma Ata, USSR). Yadern. Fiz.; 18: No. 1, 93-101(Jul 1973). (In Russian).

Production cross sections for the reactions $pp \rightarrow pp\pi^+\pi^-$, $pp \rightarrow pp\pi^+\pi^-\pi^0$, $pp \rightarrow pn\pi^+\pi^+\pi^-$ are determined applying the method of kinematical identification and the interaction process modelling. Angular and momentum distributions of nucleons and pions from the reactions are compared with predictions of theoretical models. Four-dimensional nucleon momentum transfers are analysed. Dynamical characteristics of the secondary particles at two values of the incident momentum, 19.1 and 10 GeV/c, are compared for each of the considered reactions. (auth)

Strong (Meson-induced)

Refer also to abstract 28301.

28330 (COO-2009-42) INVESTIGATION OF POSSIBLE A_2 STRUCTURE. Ankenbrandt, C. M.; Brabson, B. B.; Crittenden, R. R.; Heinz, R. M.; Mott, J. E.; Neal, H. A.; Pawlicki, A. J. (Indiana Univ., Bloomington). 1973. Contract AT(11-1)-2009. 7p. Dep. NTIS $3.00.

The results of an investigation of the significance of structure in the charged A_2 mass spectra from the reaction $\pi^+p \rightarrow A_2^+p$ at 4 GeV/c are reported. Fits to the data using the dipole and Breit–Wigner hypothesis show that the A_2^- and A_2^+ data agree with the Breit–Wigner hypothesis and reject the dipole hypothesis. (LBS)

28331 π^0 MULTIPLICITIES IN π^+p INTERACTIONS AT 10.5 GeV/c. Binkley, M. E. (Duke Univ., Durham, NC); Elliott, J. R.; Fortney, L. R.; Loos, J. S.; Robertson, W. J.; Rose, C. M.; Walker, W. D.; Yeager, W. M.; Meisner, G. W.; Muir, R. B. Phys. Lett.; 45B: No. 3, 295-298(23 Jul 1973).

Measurements of the π^0 multiplicity cross sections are reported for $n_0 \leq 6$, where n_0 is the number of produced π^0 particles, and for $N \leq 8$, where N is the number of charged particles. The inclusive π^0 cross section is 29 ± 3 mb. Values for the correlation parameters, $\langle n_0 \rangle$ and $\langle n_0(n_0 - 1) \rangle$, are also presented. (auth)

28332 LARGE MOMENTUM TRANSFER π^-p ELASTIC SCATTERING AT 13.8 AND 22.6 GeV/c. Grindhammer, Gunter. Ithaca, NY; Cornell Univ. (1973). 143p. University Microfilms Order No. 73-18,335.

Thesis (Ph.D.).

The π^-p elastic differential cross section at 13.8 GeV/c was measured for t (four momentum transfer in $(GeV/c)^2$) from −0.75 to −4.5. A dip is observed in the angular distribution at $-t \sim 2.8$ which has been observed previously at lower energies. Also the π^-p elastic differential cross section at 22.6 GeV/c was measured for t from −0.26 to −5.25. No dip but a break in the slope of the angular distribution is observed around $-t \sim 2.8$. The experimental methods, the data analysis, the main features of the angular distributions, and the energy dependence are discussed. (auth)

28333 K^+p ELASTIC SCATTERING BETWEEN 0.865 AND 2.125 GeV/c. Goldman, J. H. College Park, MD; Univ. of Maryland (1972). 190p. University Microfilms Order No. 73-18,730.

Thesis (Ph.D.).

K^+p elastic differential cross sections were measured with high statistics at twenty-two momenta between 0.865 and 2.125 GeV/c in the center of mass angular region of about $0.9 > \cos\theta > -0.9$. The data is to be used as input to an energy independent phase shift analysis of the elastic channel. It is hoped that the phase shift analysis will resolve the question of whether or not there is a Z_1^{*2+} resonance in this energy interval. The experiment was performed in a two stage, enriched kaon beam at Argonne National Laboratory. The equipment included a liquid hydrogen target, magnetostrictive read out wire spark chambers to detect the scattered particles, and an on-line computer. The actual data analysis was done completely off-line. The data is summarized in terms of legendre polynomial expansion coefficients and compared with other experiments. (auth)

28334 OBSERVATION OF BACKWARD MESON PRODUCTION IN π^-p INTERACTIONS AT 8.0 GeV/c IN A STREAMER CHAMBER. Sokolsky, P. V. Urbana, IL; Univ. of Illinois (1973). 183p. University Microfilms Order No. 73-17,643.

Thesis (Ph.D.).

This thesis is composed of two parts. The first describes the design and development of a large one cubic meter streamer chamber system with associated monitoring and photographic systems and internal hydrogen target. The physics of streamer formation, the fast high-voltage pulse generation necessary to drive the streamer chamber and the design and construction of the chamber itself are described in detail in this section. The second sec-

tion describes an experiment utilizing the streamer chamber system to study backward meson production in the reaction $\pi^- p \rightarrow pX^-$ at 8.0 GeV/c incident pion momentum. Approximately 100,000 three-view stereo photographs were taken in the first stage of this experiment; 10% of which have been measured on DOLLY, the University of Illinois automatic measuring machine. Preliminary results are presented on the reaction $\pi^- p \rightarrow p\pi^+\pi^-\pi^-$ with $\cos\theta^{C.M.}_{\pi^-p} \geq 0.8$. The reaction is characterized by strong production of unpolarized ρ^0 consistent with nucleon exchange. (auth)

28335 REACTION K + n → K + π^-p AT 3.8 GeV/c. Marshall, D. A. Urbana, IL; Univ. of Illinois (1972). 197p. University Microfilms Order No. 73-17,313.

Thesis (Ph.D.).

The ANL 30-inch bubble chamber was exposed to a separated K^+ beam at 3.8 GeV/c. The 300,000 pictures were scanned for 3- and 4-prong events. After measuring all of the 4-prong events with a stopping track and 61% of the 3-prong events, 4919 events were reconstructed which kinematically fit the reaction $K^+D \rightarrow K^+\pi^-PP$; this cross section was found to be 1.78 ± 0.10 mb. The reaction is dominated by the quasi-two body interaction $K^+N \rightarrow K^{*0}(890)P$; this cross section was found to be 0.80 ± 0.07 mb. Results of an analysis of the spin density matrix elements indicate O^- exchange is dominant. The reaction $K^+N \rightarrow K^{*0}(1420)P$ was examined for the effect reported by Firestone et al. The effect was confirmed, but the interpretation of the effect at 3.8 GeV/c as a broad S-wave resonance is clouded by a possible interpretation involving a secondary scattering between the spectator proton and the decay products of the K*(1420). (auth)

28336 NEUTRAL HYPERON PRODUCTION IN K^-d INTERACTIONS NEAR 400 MeV/c. Laumann, R. D. Madison, WI; Univ. of Wisconsin (1973). 112p. University Microfilms Order No. 73-15,975.

Thesis (Ph.D.).

A study was made of the neutral hyperon final states in K^-d interactions with an incident K^- beam momenta of 410 MeV/c and 360 MeV/c. The Λp effective mass distribution from the reaction $K^-d \rightarrow \Lambda\pi^-p$ has a pronounced peak at 2128 MeV that is enhanced by selecting events with forward π's. The peak is below Σ^+n threshold which suggests that it is a YN bound state that decays via the available Λp channel. Analysis of the data according to the formalism of Karplus and Rodberg yielded a complex scattering length of −0.8−1.8 fermi which implies the existence of a bound state. No evidence for another YN resonance was found in this reaction or in the reaction $K^-d \rightarrow \Sigma^0\pi^-p$. The beam momentum of 410 MeV/c was chosen to excite the Λ(1520). Study of the reactions $K^-d \rightarrow \Lambda\pi^+\pi^-n$ and $K^-d \rightarrow \Lambda\pi^-\pi^0p$ suggests that at least 10% of the Λ(1520) → Λππ decay mode goes through the sequence Λ(1520) → Σ(1385)π → Λππ. As the Σ(1385) is a decuplet member and the π is an octet member, observation of this decay mode provides direct evidence that the Λ(1520) is not a unitary singlet. The Yπ mass spectra from the reactions $K^-d \rightarrow \Lambda\pi^-p$ and $K^-d \rightarrow \Sigma^0\pi^-p$ showed a peak in the former for the Σ(1385) but not in the latter. This is consistent with the branching ratio into Σπ of 10%. Both spectra had either a peak or a shoulder near 1440 MeV which was enhanced by selecting forward protons. This suggests that the peaks are due to a double scattering process rather than a new resonance. A measurement of $g_{\bar{K}NY_1^*}$, assuming the validity of the impulse approximation and extrapolating off the nucleon mass shell to go below KN threshold, was performed and found to be consistent with SU(3) predictions. An extrapolation of scattering amplitudes below $\bar{K}N$ threshold was performed using K^- scattering on virtual nucleons. The results for $K^-d \rightarrow \Sigma^0\pi^-p$ obtained were consistent with the $Y_1^*(1385)$ being a resonant P_{13} amplitude. The results for $K^-d \rightarrow \Lambda\pi^-p$ agree well with previous experiments above threshold involving real nucleons. Although the P_{13} amplitude resonated below threshold, it was small compared to the S_{11} and P_{11} amplitudes. (auth)

28337 DISCREPANCY BETWEEN CERN AND SACLAY PHASE SHIFTS FOR PION–NUCLEON SCATTERING. Hoehler, G.; Kaiser, F.; Wagner, F. (Univ., Karlsruhe, Ger.). Lett. Nuovo Cim.; 8: No. 4, 232-236(22 Sep 1973).

It is pointed out that the CERN and Saclay phase shifts lead to quite different predictions for spin rotation parameters in certain kinematic regions for πp scattering. It is also pointed out that amplitudes reconstructed from phase shifts are not as reliable as generally assumed, for instance in applications of sum rules or in discussions of s-channel helicity conservation. It is suggested that the problem cannot be solved by a more sophisticated method of phase-shift analysis, even if more accurate differential cross-section and polarization data were available, and that further progress depends on new experiments such as the spin rotation experiments. (LBS)

28338 ANALYSIS OF THE REACTION $\pi^- p \rightarrow \pi^0 n$ AT HIGH ENERGIES. Babaev, Z. R.; Zamiralov, V. S.; Tarasevich, S. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 2, 415-419(Aug 1973). (In Russian).

Experimental data on the pion–proton charge–exchange reaction are analysed. It is shown that the available data admit a violation of the Pomeranchuk theorem. (tr-auth)

28339 ELASTIC $\pi^- p$, $K^- p$, AND $\bar{p}p$ SCATTERING AT THE MOMENTA 25 AND 40 GeV/c. Antipov, Yu. M. (Inst. of High Energy Physics, Serpukhov, USSR); Askoli, D.; Busnello, R. Yadern. Fiz.; 18: No. 2, 353-363(Aug 1973). (In Russian).

Data on elastic $\pi^- p$, $K^- p$ and $\bar{p}p$ scattering at the momenta of 25 and 40 GeV/c, obtained at the IHEP 70-GeV proton synchrotron, are presented. The differential cross sections and the diffraction cone slopes are given in the momentum transfer range 0.07–0.80 $(GeV/c)^2$. Comparison with the data obtained at lower energies is carried out. (auth)

28340 ELASTIC π^{-4}He SMALL ANGLE SCATTERING AT 3.48 AND 6.13 GeV/c. Nomofilov, A. A.; Sitnik, I. M.; Slepets, L. A.; Strunov, L. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 364-368(Aug 1973). (In Russian).

Differential cross sections are measured for the elastic π^{-4}He scattering in the region of small four-momentum transfers $0.0056 \leq |t| \leq 0.087$ and $0.0056 \leq |t| \leq 0.0462$ $(GeV/c)^2$ respectively. The data are analysed using the Glauber theory. The slope parameter is obtained for the spin–independent elastic πN-scattering differential cross sections. The diffraction cone slope parameter, the total elastic cross section of the π^{-4}He scattering and the equivalent radius of the nucleus ^{4}He are also determined. (auth)

28341 INELASTIC $\pi^+ p$ INTERACTIONS AT ENERGY 230 MeV. Batusov, Yu. A.; Bunyatov, S. A.; Gulkanyan, G. R.; Sidorov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 86-92(Jul 1973). (In Russian).

Cross section of the reaction $\pi^+ p \rightarrow \pi^+\pi^+ n$ at the energy T_π = 230 MeV is measured. The result enables one to exclude one of two most probable values for a parameter ξ, determining the interaction Lagrangian for the processes ππ → ππ and πN → πππN near threshold in the "soft-pion" theory. Two possible values are found for the ratio of the isospin invariant amplitudes for the reaction πN → πππN at threshold in the P_{11} and P_{31} states, which enables one to clear up the possible application of the low-energy theory of the πN → πππN reactions to determine the pion-pion scattering lengths. Cross sections of the reactions $\pi^+ p \rightarrow \pi^+\pi^0 p$ and $\pi^+ p \rightarrow \pi^+\gamma p$ ($E_\gamma > 50$ MeV) at the energy T_π = 230 MeV are estimated. The main inelastic channel at this energy is shown to be the radiative scattering with emission of hard γ quanta. (auth)

28342 MEASUREMENT OF THE PION AND NUCLEON FORM FACTORS AT THE TIME-LIKE FOUR-MOMENTUM TRANSFERS k^2 = 1.7, 2.2, AND 2.9 f^{-2}. Berezhnev, S. F.; Dem'yanov, A. V.; Kulikov, A. V.; Kuptsov, A. V.; Kurochkin, V. P.; Mkrtchyan, G. G.; Nemenov, L. L.; Pustyl'nik, Zh. P.; Smirnov, G. I.; Fedunov, A. G.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 102-108(Jul 1973). (In Russian).

Data on the reaction $\pi^- p \rightarrow e^+e^- n$ were analyzed by means of a dispersion model with the pion form factor $F_\pi(k^2)$ and the nucleon isovector Dirac form factor $F_1^v(k^2)$ as parameters. It is shown that all the experimental distributions are described by the model reasonably, if $F_\pi(k^2) = F_1^v(k^2)$. With this assumption the form factors for the momentum transfers 1.7, 2.2 and 2.9 f^{-2} are, respectively, $F_\pi = F_1^v = 1.10 \pm 0.07$, 1.14 ± 0.06, 1.30 ± 0.07. The electromagnetic radius, derived from the data, $r_{F_1^V} = r_\pi = (0.75 \pm 0.14)$ f is in agreement with the value $r_{F_1^V} = 0.82$ f, measured in the elastic eN scattering. If one assumes that the parameters are independent, they may be determined only at $k^2 = 2.9$ f^{-2}: $F_\pi = 1{,}2^{+0{,}2}_{-0{,}3}$, $F_1^v = 1{,}5^{+0{,}1}_{-0{,}2}$. (auth)

Particle Interactions and Properties (Theoretical)

General

28343 (CNRS-CPT-73-P-536) NON QUASI-FREE CLASSES OF PRODUCT STATES OF THE C.C.R.-ALGEBRA. Gille, J. F. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). May 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

Two examples of pure states of Van Hove's universal receptacle in the boson case are presented which are not unitarily equivalent to any quasi-free state. In particular, it is shown that a discrete state is unitarily equivalent to some quasi-free state, if, and only

if it is equivalent to the Fock state related to the chosen decomposition of the test function space. (auth)

28344 (NP-19833) YEARBOOK, 1972. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 156p. Dep. NTIS (U. S. Sales Only) $10.00.

Theoretical and experimental research on high energy and nuclear physics, optics, solid state physics, chemistry, nuclear energy, electronics, computing techniques, and research development and engineering of experimental equipment is summarized. A list of publications is included. (JFP)

28345 (RL-73-64) DUALITY. Phillips, R. J. N.; Roy, D. P. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 121p. Dep. NTIS (U. S. Sales Only) $8.00.

The review of duality covers analyticity, crossing symmetry, Regge poles, precise definitions of duality, particle multiplet classification, duality diagrams, dual models, and inclusive interactions. (JFP)

28346 STATISTICAL BOOTSTRAP AND THE POMERANCHUK MODEL FOR MULTIPLE HADRON PRODUCTION. Gorentshtein, M. I.; Zinov'ev, G. M.; Miranskii, V. A.; Shelest, V. P. (Inst. of Theoretical Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 447-448(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 637-639(5 Jun 1973).

Attention is called to the profound connection between the Pomeranchuk and the Hagedorn–Frautschi bootstrap models. It is shown that in the statistical bootstrap the role of the Pomeranchuk model is played not by the volume of the hadron itself but by the volume of the system of stable particles (arbitrarily pions) into which it decays. In accordance with the Pomeranchuk postulate, this volume is proportional to the number of pions, making it possible immediately to establish a correspondence between the different fireball definitions used in the two models. (JFP)

28347 UNITARIZATION OF THE MULTIPERIPHERAL MODEL. Calucci, G. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 8: No. 3, 189-192(15 Sep 1973).

The possible results of applying an s-channel unitarity constraint to a multiperipheral model are studied using an eikonal approximation built up in a form already presented and some elements of functional techniques in the estimates of the asymptotic behaviors. It is found that either the Born term decreases with the energy, and then the total cross section does the same, or the Born term grows and then the total cross section is on the average independent of the energy behavior of the Born term. (JFP)

28348 DECOUPLING OF THE TWO-POMERANCHON-CUT. Iwasaki, Y. (City Coll., New York); Yazaki, S. Phys. Lett.; 45B: No. 3, 263-266(23 Jul 1973).

The decoupling of the two-Pomeranchon-cut from two Pomeranchon-Regge poles at zero momentum transfer is proven. This implies the vanishing of the Pomeranchon-Pomeranchon-Reggeon vertex at zero momentum transfer. (auth)

28349 SHORT-RANGE CORRELATIONS IN THE CENTRAL REGION AT ISR ENERGIES. Pirila, P.; Pokorski, S. (CERN, Geneva). Lett. Nuovo Cim.; 8: No. 3, 141-144(15 Sep 1973).

The two-particle correlations originating from the existence of diffraction dissociation are compared with the predictions of a model based on independent emission of clusters of particles. It is found that the shape of the two-particle correlation function is consistent with isotropic decay of the clusters. Also the quantum number (charge) dependence of the two-particle correlation function is studied, and comparisons with the experimental data on correlations between a charged particle and a photon are presented. (JFP)

28350 SELF-CONSISTENCY CONDITIONS IN SYSTEMS WITH BROKEN SYMMETRY. Fayans, S. A.; Khodel, V. A. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 444-447(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 633-636(5 Jun 1973).

The self-consistency conditions are derived that must be satisfied by the mass operator, the density matrix, and the two-particle interaction in systems with broken symmetry. (auth)

28351 CONSTRAINTS ON POMERON COUPLINGS FROM MULTIPLE DIFFRACTIVE DISSOCIATION. Brower, R. C. (California Inst. of Tech., Pasadena); Mueller, A. H.; Sen, A.; Weis, J. H. Phys. Lett.; 46B: No. 1, 105-108(3 Sep 1973).

Double diffractive dissociation proceeding through single Pomeron exchange is shown to give a contribution to the total cross section growing like ln s, if the triple-Pomeron coupling does not vanish. Similarly, the exchange of N Pomerons would lead to a $(\ln s)^N$ growth. This inconsistency of the simple Pomeron pole model of diffractive scattering is somewhat stronger than the ln ln s inconsistency previously obtained and shows: nonvanishing of the triple-Pomeron coupling leads to a violation of the Froissart bound, and Pomeron decouplings cannot be circumvented by Regge trajectories with $\alpha'(0) = \infty$. It is noted that multiple diffraction dissociation processes are strongly constrained by unitarity whatever the detailed nature of the Pomeron. (auth)

28352 RELATIVITY AND QUANTIZING: GRAVITATIONAL ENERGY. Anastassov, A. H. (Univ., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 603-606(1973). (In French).

A previously proposed relativistic discrete model for the idea of particles is discussed. The inexact determination of observable quantities, and a pulsating nonstatic centrosymmetric metric are considered. Also another modification of the Schwarzschild metric is discussed which leads to interesting consequences. (JFP)

28353 PARTON PICTURE OF ELEMENTARY PARTICLES. Kogut, J. (Inst. for Advanced Study, Princeton, NJ); Susskind, L. Phys. Rep.; 8C: No. 2, 75-172(Jun 1973).

The parton theory is developed along several lines. One begins by developing quantum mechanics in the infinite momentum frame. The Galilean analogy is worked out and the use of nonrelativistic reasoning in relativistic context is illustrated. Applications of infinite momentum quantum mechanics include the computation of the radius of a relativistic bound state, space time visualization of the multiperipheral model, and the eikonal approach to high energy scattering. The classic phenomenological applications of the parton model are reviewed and explained. These include deep inelastic electroproduction, the shrinking photon effect and heavy lepton pair production. The string-model of hadrons is formulated in the infinite momentum frame as a parton model. Currents and the distribution of spins among the partons of the hadronic string are considered. It is suggested that it is profitable to view a hadron as a one-dimensional lattice of spins and isospins and show that many of the properties of the lattice can be related to the meson spectrum. Applications of the spin lattice idea are made to deep inelastic electron and neutrino scattering. Predictions are made for the behavior of the structure functions in these processes. Multiparticle production is examined in the string model. The distribution of secondaries is derived in longitudinal and transverse momentum, the charge per secondary as a function of rapidity and the correlations among secondaries at different rapidities. Speculations are made about a class of phenomena which go beyond the string model. These phenomena are called hard parton effects. They include the production of large transverse momenta among secondaries, logarithmically increasing total cross sections and power behaviors of wide angle exclusive cross sections. Some speculations about the breakdown of the parton model are given. (auth)

28354 SCALING AND PROPERTIES OF THE FIREBALL PRODUCTION IN THE STATISTICAL BOOTSTRAP MODEL. Csikor, F.; Katona, Z.; Montvay, I. (Eoetvoes Univ., Budapest). Lett. Nuovo Cim.; 8: No. 2, 99-104(8 Sep 1973).

The asymptotic validity of Koba, Nielsen, and Olesen scaling is assumed, and it is investigated how it restricts the properties of fireball production in the statistical bootstrap model. A simple example of models obeying scaling of the multiplicity distribution and limiting fragmentation (that is, Feynman scaling of the single-particle distribution as $x \neq 0$) is given. The multiplicity distribution of pions resulting from the decay of a fireball is considered. It is concluded that the leading fireballs are necessary in order to reconcile multiplicity scaling with limiting fragmentation. (JFP)

28355 WHAT IS THE CHARGE OF A PARTON. Koca, M. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 2, 127-131(8 Sep 1973).

In order to study whether very high energy electroproduction experiments really measure integral charges, a counter example is given of the three-triplet quark model of third integral charges which cannot be distinguished from the integrally charged three-triplet model of Han–Nambu type in the case of very high energy electroproduction experiments. The radiative decays of vector mesons are checked. It is found that at high energies above the threshold for charmed-particle production, the electroproduction experiment cannot be regarded as evidence for the existence of integrally charged partons, even if the data could be incorporated into such a model. It is shown that the exact measurements of the processes involving the squares of the charges of the fundamental triplets may determine the squares of the charm quantum numbers of the triplets. (JFP)

28356 QUASI-CLASSICAL METHODS FOR PARTICLES WITH SPIN. Mirkovitch, M. (Univ. of Michigan, Ann Arbor); Summerfield, G. C. J. Phys. (Paris); 34: No. 7, 499-509(Jul 1973). (In French).

The key concepts of the quasi-classical theory of Wigner are reviewed. In particular, the concepts of the Wigner distribution and the Wigner equivalents for operators of position and spin are presented. Then, the Groenewold multiplication rule is applied to the Heisenberg equation of motion and to certain correlation functions. Finally, these concepts are applied to the general problem of spin correlations and the spin position interaction. (auth)

28357 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 15, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 80p.

28358 PARTICLE POLARIZATION IN INCLUSIVE REACTIONS. Kudryavtsev, V. A.; Levin, E. M. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 2, 451-463(Aug 1973). (In Russian).

Polarization effects in inclusive reactions $a + b \rightarrow c + \ldots$ are discussed in case the particles a, b, c have arbitrary spins. Basing on the formalism of invariant reggeon vertices for particles with any spin, concrete predictions are presented for some polarization effects in the central reggeon domain, in the three-reggeon fragmentation domains. (auth)

28359 IS THE PHOTON STABLE? DeCelles, P. C.; Montufar, C. (Univ. of Notre Dame, IN). Lett. Nuovo Cim.; 8: No. 5, 318 (29 Sep 1973).

It is proved that the photon and the graviton are stable with respect to the $\gamma \rightarrow \gamma + g$ and $g \rightarrow \gamma + \gamma$ decay modes. (LBS)

28360 ELEMENTARY PARTICLES, GENERAL RELATIVITY, AND F MESONS. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore). Lett. Nuovo Cim.; 8: No. 5, 324-328(29 Sep 1973).

The role of general relativity theory in determining the structure of elementary particles is discussed in light of a principle postulated by Ross (Nuovo Cimento: 8A, 603(1972)). It was remarked by Ross that the electron and the proton, along with their antiparticles, are the only completely stable particles with mass, other particles being their excited states. A possible way of obtaining these excited states and of computing their energies is suggested. The analysis shows that the excited states have no relation to the observed particle spectrum. The possible importance of the f-meson strong gravity in determining the structure of hadrons or baryons is given. (LBS)

Electromagnetic

Refer also to abstracts 28647, 29130, 29135, and 29140.

28361 (AED-CONF-71-400, pp 187-192) EFFECT OF BARYON RESONANCE ADMIXTURES ON ELASTIC DEUTERON SCATTERING. Miller, H. G. (Max-Planck-Institut fuer Chemie, Mainz); Arenhoevel, H.; Williams, H. T. 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Deuteron form factors were calculated with admixtures of baryon resonances in the deuteron wave function. In this formulation the individual nucleons are no longer considered to be dynamically structureless particles, but rather to have an intrinsic structure, i.e., a spectrum of excited states. The probability for occurrence of these admixture configurations is generally small, not more than a few per cent. However, since their respective wave functions peak at about 0.7 fm and fall off rapidly with increasing r, the high-momentum components in the wave function are enhanced. For this reason elastic e–d scattering was investigated at high momentum transfers. The most dominant contribution stems from the configuration containing two $\Delta(1236)$ resonances, which occurs with a probability of 0.9%. Calculations show that the structure functions are increased from 10 to 30%, which is of the same order as present discrepancies between theoretical calculations and experimental data. (2 figures) (RWR)

28362 (DESY-73/15) ONE-PARTICLE AND TWO-PARTICLE INCLUSIVE DEEP INELASTIC ELECTRON–POSITRON ANNIHILATION IN A MASSIVE QUARK MODEL. Gatto, R.; Preparata, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

A massive quark model is reviewed and elaborated upon. The model is applied to deep inelastic electron-positron annihilation into hadrons. Definite predictions are given for one-particle inclusive and two-particle inclusive annihilations. Predictions for multiplicities, angular distributions, transverse momentum distribution in two-particle inclusive reactions, correlations, and threshold behavior, are given. Exclusive annihilation into two mesons is also calculated. (GE)

28363 (DESY-73/16) CMSR's FOR SINGLE CHARGED PION PHOTOPRODUCTION AMPLITUDES AND THE ROLE OF THE GAUGE INVARIANT BORN TERMS. Logothetidou, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25.

Continuous moment sum rules (CMSR's) for the t-channel isospin-odd single pion photoproduction amplitudes are considered in great detail. Information about the high energy behavior of the amplitudes is extracted from low energy data in terms of an "effective" Regge pole picture which in most cases turns out to strongly violate certain reasonable postulates about the behavior of "pure" Regge pole s. ("idealized Regge pole picture"). One asks whether the deviation of the "effective" Regge pole picture from the "idealized" one can be described in terms of fixed poles at J = 0 arising from certain parts of the gauge invariant Born term contributions to the amplitudes. Investigation of CMSR's for amplitudes from which appropriate parts of the Born terms have been separated out, leads to a definite finite energy sum rule (FESR) duality scheme where parts of the Born terms "build up" the "idealized" Regge poles themselves, while other parts give rise to additional contributions on the high energy side of the CMSR's. (GE)

28364 (DESY-73/17) APPLICATION OF K-MATRIX CMSR'S TO SINGLE CHARGED PION PHOTOPRODUCTION. Logothetidou, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

The background terms required, additional to Regge poles with some definite properties, in order to describe the high energy behavior of the t-channel single pion photoproduction amplitudes are investigated in the framework of a reggeized K-matrix model. For this purpose, continuous moment sum rules (CMSR's) are applied, not to the full amplitudes, but just to the two-particle K-matrix amplitudes assumed to show pure Regge pole asymptotic behavior. The K-matrix amplitudes are defined by taking into account in the Bethe–Heitler equation the elastic (πN)-intermediate state only. Such a definition corresponds to a weak cut model with only "final state" interaction included. It turns out that strong background contributions are still present on the high energy side of the K-matrix CMSR's. The Regge cut contributions generated within the formalism are found to be too weak to account for the background terms in the full amplitudes. (GE)

28365 (DESY-73/28) REMARK ON THE PRECOCITY OF SCALING IN DEEP INELASTIC ELECTRON PROTON SCATTERING. Gorczyca, B.; Schildknecht, D. (Deutsches Elektronen Synchrotron, Hamburg (West Germany)). Jul 1973. 15p. Dep. NTIS (U.S. Sales Only) $3.00.

It is quantitatively shown that precocity of scaling is largely due to the contribution of the low-lying vector mesons to the virtual forward Compton scattering amplitude. (auth)

28366 (EFI-TF-5(72)) ELECTROMAGNETIC MECHANISM OF INELASTIC HADRONS COLLISION AT HIGH ENERGIES. Matinyan, S. G.; Ter-Isaakyan, N. L.; Khoze, V. A.; Shakhnazaryan, Yu. G. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1972. 20p. (In Russian). INIS.

It was shown that at high momentum transfer the cross section of the hadron interaction with formation of two beams, undergoing one-photon exchange, is significant and apparently significantly predominates over the cross section of analogous processes caused by strong interactions. The phenomena connected with the electromagnetic mechanism of inelastic hadron collision at both high and low momentum transfer were examined in detail. (tr-auth)

28367 (EFI-TF-7(71)) DETERMINATION OF THE RADII OF ELEMENTARY PARTICLES (π,p) BASED ON THE ANALYTICAL PROPERTIES OF THEIR FORM FACTORS. Baluni, V. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 22p. INIS.

On the basis of the analytical properties of the electromagnetic form factor the upper and lower bounds on the mean square radius of the elementary particle are established by two different methods. The first method makes use of the experimental distribution of the magnitude of the form factor modulus in the annihilation channel. In addition to the latter, the second method makes use of the experimental value of the form factor in some space-like point. Within experimental errors, both methods give the same value for π-meson rms radius ($r_\pi = 0.7 \pm 15F$). The upper and the lower bounds on the proton rms radius are also obtained ($0.7 \pm 0.12F < r < 1.05 \pm 0.06F$). (auth)

28368 (EFI-TF-9(71)) K-MESONS PHOTOPRODUCTION IN REGGE POLES MODEL WITH CUTS ACCOUNT. Arakelyan, G. G.; Amatuni, A. T.; Garyaka, A. P.; Eremyan, Sh. S.; Zverev, A. M. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 14p. (In Russian). INIS.

The photoproduction of charged and neutral K mesons was examined. In the reaction with formation of charged K mesons, the contributions of K and K^x trajectories and of K^xp cross sections were taken into account. In the photoproduction of neutral K mesons the contribution of K^x trajectories and K^xp cross sections were taken into account. Curves were obtained for the differential cross section and the asymmetry coefficients of the processes examined. (tr-auth)

28369 (IC-72-114) FERMION STATES OF A BOSON FIELD. Barut, A. O. (International Centre for Theoretical Physics, Trieste (Italy)). 1972. 6p. INIS.

The spin $\frac{1}{2}$ bound state of two spinless doubly-charged particles (dyons) provides another example of a fermion state of the underlying electromagnetic boson field and, contrary to recent claims, does not require abnormal statistics for the spin-0 dyons. The wave functions of dyonium are shown to be elements of the space $L^2(R^3 \otimes S^2)$. A generalization of the Ehrenfest–Oppenheimer theorem is given. (auth)

28370 (RISO-M-1615) PAACFIT: A PROGRAM FOR ANALYZING POSITRON ANNIHILATION ANGULAR CORRELATION SPECTRA. Kirkegaard, P.; Mogensen, O. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

A computer program is described that analyzes angular correlation spectra from positron annihilation by a least squares technique of the semilinear Marquardt type. The model includes a sum of central peaks and side peaks, all of Gaussian shape. Fixed values can be imposed on any number of the fwhm and relative intensities, and any linear combination of intensities may be fixed to zero. The results include the variance-covariance matrix of the fitted parameters. Illustrative examples of use of the program are presented, and a discussion is given of the physical interpretation of the results, based on experience from about 500 analyses of more than 100 angular correlation curves. (auth)

28371 ELECTRIC BORN MODEL AND PION FORM FACTOR. Suleimanov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 431-433 (5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 613-616(5 Jun 1973).

By choosing the electromagnetic pion form factor $F_\pi(k^2)$ in the form $(1 + 0.04k^2/m_\pi^2 - 0.108(k^2/m_\rho^2)^2)/1 - k^2/m_\rho^2)$ for k^2 in the interval from 0.26 to 0.83 $(GeV/c)^2$ a satisfactory description of the experimental data on the electroproduction of π^+ mesons on hydrogen is obtained on the basis of the electric Born model. (auth)

28372 HADRONIC SHADOWING EFFECTS IN HIGH ENERGY PHOTON-NUCLEUS INTERACTIONS. Weise, W. (Univ., Erlangen, Ger.). Phys. Lett.; 45B: No. 3, 219-223(23 Jul 1973).

A simple model is proposed to describe the hadronic shadowing effects observed in total photon-nucleus cross sections at high energies. The model combines the existence of hadronic components in the photon propagator with the Glauber theory of multiple scattering, without paying explicit reference to the ρ-dominance picture. Some consequences of the present treatment are discussed and compared to previous work. (auth)

28373 CURRENT PRODUCTS AND COORDINATE SPACE ANALYSIS. Ezawa, Z. F. (Tokyo Univ.). Lett. Nuovo Cim.; 8: No. 3, 137-140(15 Sep 1973).

The origin of the positive infinity associated with the Schwinger term is clarified, and it is shown that the divergent representation is rather natural for a given matrix element. It is argued that eventually it is a matter of taste to choose the infinite or finite representations. The deep inelastic electron scattering e + p → e + anything is considered. (JFP)

28374 INVESTIGATION OF WARD IDENTITIES FOR ETA MESON DECAY USING NONLOCAL CURRENTS. Ar, C. A. Los Angeles; Univ. of California (1973). 70p. University Microfilms Order No. 73-18,612.

Thesis (Ph.D.).

The experimentally observed decay rate for $\eta \to 3\pi$ disagrees with the predictions of current algebra and partial conservation of the axial-vector current. The existence of "anomalies" in the axial-vector Ward identities for the process could provide a possible explanation. If present, such anomalies should manifest themselves in the failure of formally derived identities to be satisfied when matrix elements for specific processes are calculated (the origin of the problem lying in the unreliability of formal manipulations involving products of fermion fields defined at the same space-time point). Using perturbation theory in spinor electrodynamics, Abers, Dicus and Teplitz (ADT) have conducted an investigation of anomalies for $\eta \to 3\pi^0$ and the related process $\eta \to \pi^0\sigma$. They conclude that in both cases formally divergent terms (double-loop integrals) are present in the associated axial-vector Ward identities. For $\eta \to \pi^0\sigma$, they argue that the anomaly vanishes if electromagnetic gauge invariance is imposed. For $\eta \to 3\pi^0$, they show that if a particular prescription is used in assigning the internal loop momenta, the anomaly again vanishes. The present study is a re-examination of the processes considered by ADT using a split-point definition of the axial-vector current. By retaining a finite value of the point-splitting four vector ϵ during the formal manipulations, an attempt is made to eliminate some of the ambiguity of the perturbation theory calculation. The conclusions of this investigation are in basic agreement with ADT, but the anomalies can apparently be shown to vanish without making the assumptions mentioned above. In the $\eta \to \pi^0\sigma$ case, the anomaly is shown to be zero prior to taking the $\epsilon \to 0$ limit by making certain changes of variable (which are reliable for finite ϵ) in the integral representing the anomaly. The result is shown to be independent of gauge invariance. For $\eta \to 3\pi^0$ the anomaly has the form $\epsilon^\alpha I_\alpha(\epsilon)$, where $I_\alpha(\epsilon)$ is a convergent integral in the $\epsilon \to 0$ limit. Hence, the anomaly vanishes when the limit is taken. Thus, the naive Ward identities appear to be satisfied for both processes. (auth)

28375 DUALITY IN $e^+ + e^- \to$ HADRONS. Sakurai, J. J. (Univ. of California, Los Angeles). Phys. Lett.; 46B: No. 2, 207-210(17 Sep 1973).

A new kind of duality relation is conjectured between vector meson formation and scaling (1/s) behavior in the total cross section $\sigma_{had}(s)$ for $e^+ + e^- \to$ hadrons. On the basis of a finite-energy sum rule it is demonstrated that the parameters of the ρ, ω and ϕ peaks are sufficient to determine the asymptotic value of $\sigma_{had}(s)$ to be three to five times the muon pair cross section provided $\sigma_{had}(s)$ goes like 1/s at high energies. (auth)

28376 SCATTERING OF LIGHT BY LIGHT IN A VACUUM FREE OF THE INFLUENCE OF ANY FIELD. Hughes, J. H. (Australian National Univ., Canberra). Phys. Lett.; 46B: No. 2, 211-213(17 Sep 1973).

Threshold values are derived for interactions of widely different order associated with the scattering of light by light in a vacuum free of any fields. It is concluded that threshold values of lowest order may be within the capabilities of lasers. (auth)

28377 LIGHT-CONE APPROACH TO HADRON MASS DIFFERENCES IN UNIFIED GAUGE THEORY. Tataru, L. (Univ. of Craiova, Bucharest). Phys. Lett.; 46B: No. 2, 221-224(17 Sep 1973).

Using light-cone algebra, the cancellation mechanism of the divergent contributions to the hadron mass differences is investigated in those models which satisfy Weinberg's finiteness condition. (auth)

28378 THEORETICAL FRAMEWORK FOR FINAL STATE PRODUCTION IN DEEP INELASTIC LEPTON–HADRON SCATTERING. Kishlinger, M. B. (Univ. of Chicago). Phys. Lett.; 46B: No. 2, 225-227(17 Sep 1973).

A two step description of deep inelastic electroproduction is proposed and the ideas are formulated within the framework of the quark parton model. A generalization of the ideas of Mueller is used to describe the interaction of partons to form the final state hadrons. It is predicted that at ultra-high energies $(2M\nu + q^2) \to 0(10^2 GeV^2 - 10^3 GeV^2)$. Bjorken scaling will be violated, but only by factors of $\ln(2M\nu + q^2)$. Predictions for inclusive current-hadron production are also given. (auth)

28379 PROCESS $\gamma\gamma \to$ X BY THE PARTON MODEL AND PREDICTION OF EQUIVALENT-PHOTON METHOD FOR ee → ee + X. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Phys. Lett.; 46B: No. 2, 237-239(17 Sep 1973).

A parton model for the virtual photon process $\gamma\gamma \to X$ is examined. It is assumed that a scaling property applies and the total cross section is $\sigma_{\gamma\gamma \to X} = s^{-1}\,\phi(\xi)$, where the function ϕ is dependent on the scaling variable ξ defined by $\xi = s/(q_1^2 q_2^2)$. The cross section for the process ee → ee + X is calculated using the equivalent-photon technique. (auth)

28380 CLOSE RELATION BETWEEN QUARK FRAGMENTATION FUNCTIONS AND QUARK DISTRIBUTION FUNCTIONS. Motivation and Consequences. Kim, B. R.; Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 8: No. 4, 213-220(22 Sep 1973).

The various similarities between the quark fragmentation functions $D_i^h(z)$ and the quark distribution functions $d_i^h(x)$ within the framework of the quark parton model are pointed out, which lead to the investigation of the following ansatz: $D_i^h(z) = \psi(z) d_i^h(z)$, where $\psi(z) > 0$ is a universal function independent of i and h. Some predictions and possible tests of the ansatz for ep, en, νp, and $\bar{\nu}$p interactions are presented. (LBS)

28381 PHOTOPRODUCTION OF PSEUDOSCALAR MESONS AT HIGH ENERGY. Ray, S. R. Montreal; McGill Univ. (1972). National Library of Canada, Ottawa.
Thesis (Ph. D.).
Firstly, forward photoproduction of neutral pi and eta mesons is simultaneously described in terms of models involving Regge poles and Regge cuts. Two distinct models are used to produce good fits to the existing data—the Dual Absorptive Model (DAM) and the Weak Cut Model (WCM). This analysis is extended to certain quantities of the processes $\pi N \to \omega N$ and $\pi N \to \rho N$ through the use of vector dominance relations. The suitability of using the absorption prescription to calculate the Regge cut contributions corresponding to Reggeized vector exchanges for the imposition of the DAM requirements is discussed. The DAM results are compared to those of the WCM and some tests for experimentally distinguishing between these two models are suggested. Secondly, photoproduction of charged pions in both forward and backward directions is discussed in detail in terms of the Veneziano model, a crossing symmetric dual model. A simple model with a small number of beta functions (and essentially without any free parameters) is seen to explain the forward structure of different experimental quantities and also to correctly predict the residues of some higher baryon resonances. In the backward direction, the introduction of some satellite terms is seen to be necessary to account for the differential cross sections. (auth)

28382 DEEP INELASTIC ELECTROPRODUCTION AND WEINBERG'S MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Shifman, M. A.; Shmatikov, M. Zh. (Inst. of Atomic Energy, Moscow). Lett. Nuovo Cim.; 8: No. 4, 201-207 (22 Sep 1973).
The effect of the neutral axial current in Weinberg-type unified theories of weak and electromagnetic interactions is investigated by evaluating the longitudinal polarization of the scattered lepton and the difference between the cross sections of the reactions $e^- + N \to e^-$ + hadrons and $e^+ + N \to e^+$ + hadrons. (LBS)

28383 LIGHT CONE PHYSICS. Problems and Perspectives. Preparata, G. (Univ., Rome). Riv. Nuovo Cim.; 3: No. 2, 180-193(1973).
An attempt is made to give a concise summary of the various directions in which research has proceeded in the field of light-cone physics. Light-cone tools and technology are discussed in the canonical framework. Direct applications of light-cone physics are reviewed: the total e^+e^- annihilation cross section; deep inelastic electron and neutrino scattering; and massive μ pair production in pp collisions. Indirect applications to crossing and mass dispersion relations are also discussed. (LBS)

28384 NEW SUM RULE FROM THE PARTON MODEL. Jengo, R.; Petersson, B.; Sourlas, N. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 46B: No. 2, 249-251(17 Sep 1973).
A photoabsorption sum rule, derived in the framework of the parton model is presented. The sum rule agrees with the experimental data. (auth)

28385 THOMAS PRECESSION AND MOTION OF CHARGED PARTICLES. Honig, E. New York; New York Univ. (1973). 116p. University Microfilms Order No. 73-19,933.
Thesis (Ph.D.).
A global invariant definition of Thomas precession in special and general relativity is presented. It furnishes the finite angle of precession corresponding to the finite motion of a particle along any arbitrary timelike world line. An expression for the angular velocity of precession is derived. When the formalism is specialized to flat spacetime, the expression reduces to its standard form. An invariant geometrical description of the world lines corresponding to charged particles in arbitrary homogeneous electromagnetic fields is presented. This is accomplished through the combined use of the Frenet–Serret equations and the Lorentz equation. Though the formalism was restricted here to flat spacetime, the results are the same in general relativity. The intrinsic scalars associated with these curves (i.e., their curvatures and first and second torsions) are found to be constant when they are well defined. Moreover, they form simple relations with the field invariants as well as with the energy and momentum densities of the rest frame fields. The conditions under which these scalars are well defined are established. When they are evaluated in the instantaneous rest frame of the particle, the Frenet vectors lend themselves to simple physical interpretation. It is shown that one cannot distinguish in an intrinsic geometrical manner between the curves of positive and negative charges. The same is true for positive and negative magnetic monopoles if they exist. In such a case, however, one would be able to distinguish intrinsically between ordinary and magnetic charges. A general covariant solution to the Lorentz equation for arbitrary homogeneous fields is exhibited. It is used in classifying the various types of curves that can arise here. The classical motion of spin precession, corresponding to a point particle with spin moving in an arbitrary electromagnetic field, is reviewed. It is then described in terms of an arbitrary Cartan Repère Mobile associated with the particle's world line. In particular, the spin precession is viewed in Fermi, Michel, and Frenet tetrads. (Diss. Abstr.)

28386 MODIFICATIONS OF THE CLASSICAL THEORY OF A POINT CHARGE. Cummings, L. C. Tempe, AZ; Arizona State Univ. (1973). 92p. University Microfilms Order No. 73-19,624.
Thesis (Ph.D.).
Two modifications of the classical theory of a point charge consistent with Maxwell's equations and momentum conservation are considered as possible answers to some of the problems existing in the present theory. Four alternative energy momentum tensors are considered. These alternative tensors predict a force on a point charge other than the Lorentz force. This new force, called the canonical force, requires a new definition for the momentum of the charge. However, the resulting equations of motion are the same as the conventional ones, either the Lorentz equation (test charge), or the Lorentz–Dirac equation (including radiation), so that no modifications were introduced for the observed motion of a point charge. The relation between the motion of a point charge and its current as the source in Maxwell's equations is modified by the addition of an anomalous current perpendicular to the charge's velocity, and the equations of motion are calculated. It is found that there are stable nonradiating solutions for such a particle in a central potential. (Diss. Abstr.)

28387 SCALING IN DEEP INELASTIC PION ELECTROPRODUCTION. West, G. B. (Stanford Univ., CA). Phys. Lett.; 46B: No. 1, 111-113(3 Sep 1973).
An attempt is made to apply a light cone dominance technique to the deep inelastic electroproduction of pions. A scaling law is derived which is in agreement with preliminary data. (auth)

28388 FINITE ELECTROMAGNETIC MASS DIFFERENCE OF PIONS AND TENSOR GRAVITY. Palla, L.; Pocsik, G. (Eotvos Lorand Univ., Budapest). J. Phys., A (London); 6: No. 9, 1397-1402(Sep 1973).
It is shown how the tensor gravity makes the electromagnetic mass splitting of pions finite without using any lagrangian model for the strong interaction. The mass splitting is sensitive to the spectral-function sum rules. A finite mass splitting does not lead to a unique modification of the second Weinberg sum rule. For the electromagnetic mass difference of pions good values are obtained by suitable chosen input data. (auth)

28389 WAVE PACKETS OF RELATIVISTIC ELECTRONS. Bakke, F.; Wergeland, H. Ark. Fys. Seminar Trondheim; No. 8, 1-20(1973).
It is shown that wave packets of δ-function type can be constructed without invoking negative energies. The position uncertainty is computed for a typical packet. Unlike the purely diffusive spreading known from nonrelativistic quantum mechanics, the relativistic wave packets always have a wavelike precursor on the light cone. (auth)

28390 ELECTROMAGNETIC INTERACTIONS BETWEEN PARTICLES WITH ARBITRARY SPIN, BASED UPON WEINBERG'S EQUATION. I. Elastic Scattering. Eeg, J. O. (Univ., Oslo). Phys. Norv.; 6: No. 3-4, 153-170(1972).
Some properties of Weinberg's equation and the corresponding generalized γ-matrices are presented. Cross sections for elastic scattering of particles with arbitrary spin are given. Form factors are inserted phenomenologically. Detailed calculations are given to some extent for spins $s \leq 5/2$. (auth)

28391 PHOTON REST MASS AND THE MASS OF THE UNIVERSE. Byrne, J. C.; Burman, R. R. (Univ. of Western Australia, Nedlands). Lett. Nuovo Cim.; 8: No. 2, 95-96(8 Sep 1973).
Conditions on the mean mass density both of the universe and of clusters of galaxies are used to estimate the upper limits that could be obtained for the photon rest mass in the event of the existence of intergalactic magnetic fields being established. A photon rest mass of less than $3(10)^{-20}$ g is found. If the interpretation given of the Faraday rotation data is correct and if the rest mass of the photon is about $3(10)^{-54}$ g then the missing mass of the Coma cluster of galaxies may be the mass equivalent of the energy density associated with a magnetic field. (JFP)

28392 CONSISTENT SOLUTION FOR ANNIHILATION AND ELECTROPRODUCTION CROSS SECTIONS FROM PERTURBATION THEORY AT INFINITE MOMENTUM. Griffith, R. W. (Univ., Bonn). Lett. Nuovo Cim.; 8: No. 2, 73-78(8 Sep 1973).
From perturbation theory in the infinite-momentum limit the Kaellen–Lehmann sum rule for Z_3 is recovered, and a new integral

equation which involves the total cross section for the scattering of a virtual photon (with transverse helicity) and a proton. The equation permits a consistent solution for both γp total cross sections and the total cross section for e^+e^- annihilation into hadrons. Diffractive virtual Compton scattering is also considered. (JFP)

28393 KILLING TENSORS AND CONSTANTS OF MOTION. Sommers, P. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.); 14: No. 6, 787-790(Jun 1973).

Some general properties belonging to constants of motion for geodesics and charged particle orbits are derived. A constant of motion for geodesics is seen to be a function on the cotangent bundle which has vanishing Poisson bracket with the "energy function" determined by the metric tensor. The resulting algebraic structure on the set of constants of motion is closely related to the Lie algebra of Killing tensors. Each constant of motion is shown to provide a family of mappings of geodesics into geodesics. Constants of motion for charged particles also possess a Lie algebra structure. The relation of Killing tensors to charged constants of motion is derived. The linear and quadratic constants of motion for charged particle orbits in the charged Kerr metric illustrate the results. Examples of valence 2 Killing tensors are given. (auth)

28394 RETARDATION IN ELASTIC PHOTON SCATTERING ON HYDROGEN ATOM. Granovskii, Ya. I.; Nechet, V. I. (Donetsk State Univ., USSR). Yadern. Fiz.; 18: No. 2, 381-383(Aug 1973). (In Russian).

Amplitude of the photon forward scattering on the 1S-state hydrogen atom is calculated. A method for account of the retardation leading to a familiar result is presented. (auth)

28395 MAGNETIC MOMENT OF THE DEUTERON AND NUCLEON–NUCLEON SPIN–ORBIT POTENTIALS. Shyam, R.; Mukherjee, S. (Banaras Hindu Univ., India). pp 133-137 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28396 $\pi^0 \rightarrow e + \bar{e}$ DECAY. Romanova, T. S.; Satsunkevich, I. S. (Inst. of Physics, Minsk). Yadern. Fiz.; 18: No. 2, 384-385(Aug 1973). (In Russian).

Some reasons are presented for the old experimental works on search for the $\pi^0 \rightarrow e + \bar{e}$ decay to be continued advisably. It is pointed out that the unitarity limit for the decay does not depend on assumption about the CP violation. (auth)

28397 PROOF OF THE DRELL–YAN FORMULA. Pavkovic, M. I. (New York Univ., NY). Nuovo Cim.; 17A: No. 2, 375-382 (21 Sep 1973).

Working within the recently developed unified approach to resonances and partons, the validity of the Drell–Yan formula is proved when the formula is applied to each individual quark–parton form factor separately. In the absence of some unlikely pathologies the formula works for the overall nucleon system as well. (auth)

28398 HIGH ENERGY PHOTOPRODUCTION IN A DUAL RELATIVISTIC QUARK MODEL. Venturi, G. (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cim., 17A: No. 2, 343-354(21 Sep 1973).

The high-energy photoproduction and scaling limits of a previously constructed model for pion electroproduction off nucleons are studied. The amplitude has a satisfactory quark model mass spectrum, spin structure and factorization properties on the leading trajectory. Reasonable values are obtained for forward and backward photoproduction peaks. These results and their significance are discussed and backward pion–nucleon scattering is also examined in the same scheme. Lastly the possibility of our fixed final multiplicity amplitude contributing to the scaling limit of the imaginary part of a Compton-scattering amplitude is examined. (auth)

28399 INCLUSIVE HADRON PHOTOPRODUCTION IN THE QUARK MODEL. Kobrinskii, M. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 1, 179-181 (Jul 1973). (In Russian).

Various possibilities to describe the inclusive hadron photoproduction in framework of the quark model are considered. It is shown that this model supplemented with the vector-meson dominance hypothesis enables one to describe the experimental inclusive photoproduction cross section in the fragmentation region without additional free parameters. (auth)

28400 SINGLE MUON PRODUCTION IN COLLIDING ELECTRON–POSITRON BEAMS. Sushkov, O. P.; Flambaum, V. V. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 18: No. 1, 159-161(Jul 1973). (In Russian).

Total cross sections are calculated for processes $e^- + e^\pm \rightarrow \mu^\pm(e^\pm) + e^- + \bar{\nu} + \nu$. The Weizsacker–Williams method is found to be invalid in this case. (auth)

28401 SCATTERING OF LIGHT BY A CHARGE IN AN EXTERNAL ELECTROMAGNETIC FIELD. Doktorov, E. V.; Malkin, I. A.; Man'ko, V. I. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 1, 142-152(Jul 1973). (In Russian).

Cross section for scattering of light by a charged particle moving in an external electromagnetic field is calculated by means of the coherent state method. (auth)

Weak

Refer also to abstract 28636.

28402 (ISS-72/16) RECENT DEVELOPMENTS IN THE THEORY OF WEAK INTERACTIONS. Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 20 Dec 1972. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Recent attempts to construct a renormalizable theory of weak and electromagnetic interactions, based on gauge fields, are reviewed. (auth)

28403 $\Sigma^+ \rightarrow p\gamma$ PUZZLE. Kimel, I. (Univ., Sao Paulo, Brazil). Lett. Nuovo Cim.; 8: No. 3, 166-170(15 Sep 1973).

An examination is made of the puzzle that the $\Sigma^+ \rightarrow p + \gamma$ decay gives very small asymmetry parameters using exclusive pole models and current algebra. The amplitudes and branching ratio are found. The belief is dispelled that the large experimental asymmetry parameters constitute a puzzle from the theoretical view point. (JFP)

28404 TESTING GAUGE THEORIES OF WEAK INTERACTIONS IN THE DEEP INELASTIC REGION. De Alwis, S. P. (Cambridge Univ., Eng.). Phys. Lett.; 45B: No. 3, 253-258 (23 Jul 1973).

The analogs of the Adler sum rule and the Llewellyn–Smith relation for the Georgi–Glashow and Lee–Prentki–Zumino models for weak interactions are derived. It is suggested that these could provide useful tests of the models. (auth)

28405 DISPERSION CALCULATIONS FOR WEAK INTERACTION MODEL. Fukuda, R. (Kyoto Univ.); Sasaki, R. Phys. Lett.; 45B: No. 3, 250-252(23 Jul 1973).

Dispersion calculations are performed for electromagnetic form factors of leptons and scattering amplitude using a renormalizable model of weak interactions. An unambiguous result is obtained for the anomalous magnetic moment and an unsubtracted dispersion relation holds for elastic $\nu\nu$-scattering. (auth)

28406 $K_L - K_S$ REGENERATION. Kleinknecht, K. (Univ., Dortmund, Ger.). Fortschr. Phys.; 21: No. 2, 57-84(1973). (In German).

The discussion of $K_2 - K_1$ regeneration covers regeneration amplitudes, detection of charged K^0 decays, transmission and diffraction regeneration from nuclei, regeneration from hydrogen and asymptotic behavior of total cross sections, and regeneration from electrons. (JFP)

28407 RECENT DEVELOPMENTS IN THE THEORY OF WEAK INTERACTIONS. Maiani, L. (Istituto Superiore di Sanita, Rome). Riv. Nuovo Cim.; 3: No. 2, 165-179(1973).

A review is given of the progress made and of the difficulties encountered in the effort to solve the divergence problem by constructing a realistic renormalizable field theory of weak interactions. The topics covered are gauge theories, renormalizability of gauge theories, higher-order effects, Adler–Schwinger anomalies, and models of weak and electromagnetic interactions. Two examples of field theories exhibiting the Goldstone and Higgs phenomena are given in the Appendix. (LBS)

28408 NONRELATIVISTIC QUARK MODEL AND OCTET DOMINANCE IN CABIBBO'S WEAK HAMILTONIAN. Naito, S. (Osaka City Univ.). Lett. Nuovo Cim.; 8: No. 4, 221-224(22 Sep 1973).

It is considered that the octet baryon decays $B_i \rightarrow B_f + \pi$ are described by a quasi-hadronic scattering process $S + B_i \rightarrow \pi + B_f$, in which the weak interaction acts like a scalar or a pseudoscalar spurion S carrying zero energy and momentum. The dominance of octet scalar spurion is shown by using the SU(3) symmetry only for vertices, with the help of the nonrelativistic quark model together with the dynamical assumptions adopted by previous authors. (LBS)

28409 CALCULATION OF SEMILEPTONIC NEUTRAL CURRENTS ASSUMING PARTONS AND WEINBERG'S RENORMALIZABLE THEORY. Palmer, R. B. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 46B: No. 2, 240-244(17 Sep 1973).

The Weinberg renormalizable theory of weak and electromagnetic interactions and its simple extension to hadron interactions are applied to a simple parton model. Strange partons are neglected. Inelastic neutrino and antineutrino cross sections for charged and neutral currents are expressed as functions of the parton charges, the Weinberg angle and the parton distributions in the Feynman variable x. Using the experimental charged current results, the neutral current to charged current total-cross section ratios are given as a function of the Weinberg angle for both integral and fractionally charged partons. Comparing these ratios with the experimental limits it is concluded (a) that integral charges are excluded, and (b) that, given fractional charges, the Weinberg angle is constrained to be 40° ± 5°. It is shown that this result is not inconsistent with other published limits. (auth)

28410 PROCESSES OF ANTINEUTRINO ABSORPTION WITH A POLARIZED ELECTRON. Yakh'yaev, R. Sh. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 93-99(1972). (In Russian).

The cross section of the process of the formation of hadron pairs during antineutrino-electron interactions was calculated. The formation of pion pairs during antineutrino-electron scattering was examined with a consideration of the polarizing properties of the lepton and the formation of baryon pairs during the collision of antineutrinos with electrons. Expressions were obtained for the calculation of the differential cross section of these processes. (tr-auth)

28411 PARITY-CONSERVING NONLEPTONIC DECAYS OF HYPERONS. Kaushal, V.; Khanna, M. P. (Panjab Univ., Chandigarh, India). Lett. Nuovo Cim.; 8: No. 2, 93-94(8 Sep 1973).

Considering that the parity-conserving decays arise from the symmetry-breaking effects it is shown that the simple consideration of the medium strong mass symmetry-breaking effects in fact leads to good agreement of the theoretical amplitudes with experimental results. In order to see this it is observed that the expressions for the parity-conserving decay amplitudes in the quark density model can be rewritten by including mass symmetry-breaking corrections. The decays of Λ, Σ^+, Σ^-, and Ξ^- are discussed. (JFP)

28412 PSEUDO-CABIBBO STRUCTURE AND NONLEPTONIC WEAK INTERACTIONS. Alles, W. (Univ., Bologna); Julve Perez, J. Lett. Nuovo Cim.; 8: No. 2, 123-126(8 Sep 1973).

An extension to hadrons of the unified gauge theories of weak and electromagnetic interactions encounters in general difficulties in reconciling the Cabibbo structure of the hadron current with the experimental absence of $\Delta S = 1$, $\Delta Q = 0$ semi-leptonic processes and the smallness of the K_2–K_1 mass difference. PCAC and charge-current commutation relations are assumed valid, and the low energy approach is repeated for the $(V - A)(V + A)$ Lagrangian. It is found that the pseudo-Cabibbo structure of the Lagrangian leads when combined with PCAC and charge-current algebra to disagreement with the experimentally well satisfied $\Delta T = \frac{1}{2}$ rule. (JFP)

28413 SOME GENERALIZATIONS OF THE WEINBERG MODEL. Dolgov, A. D.; Okun, L. B.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 46B: No. 1, 70-72(3 Sep 1973).

A generalization of the Weinberg model of leptons is proposed which introduces additional gauge fields. Experimental consequences for the amplitude of νe scattering the W-boson masses are discussed. (auth)

28414 IS THE NEUTRINO A GOLDSTONE PARTICLE? Volkov, D. V.; Akulov, V. P. (Physical-Technical Inst., Kharkov). Phys. Lett.; 46B: No. 1, 109-110(3 Sep 1973).

Using the hypotheses, that the neutrino is a Goldstone particle, a phenomenological Lagrangian is constructed, which describes an interaction of the neutrino with itself and with other particles. (auth)

28415 DUAL PARTON MODEL, LEPTON–HADRON RELATION, AND DEEP INELASTIC NEUTRINO–NUCLEON SCATTERING. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); Patari, K.; Das, A. Lett. Nuovo Cim.; 8: No. 5, 329-335(29 Sep 1973).

A dual parton model for hadrons was previously formulated, in which it was assumed that partons can behave as leptons. The implications of this model for inelastic neutrino–nucleon interactions and for lepton–hadron sum rules are discussed, and it is shown that the experimental results indeed support such a model. (LBS)

28416 REACTION $\nu + p \rightarrow \mu^- + \pi^+ + p$. Nuyts, J. (Univ., Mons, Belg.). Lett. Nuovo Cim.; 8: No. 5, 285-288(29 Sep 1973).

The importance of studying in a detailed manner the exclusive reaction $\nu + p \rightarrow \mu^- + \pi^+ + p$ is stressed. A $(q^2, 2pq)$ plot (q is the energy-momentum of the current, p is the energy-momentum of the initial proton) is presented, and the results are discussed in two different models. (LBS)

28417 NEW CLASS OF WEAK-INTERACTION THEORIES. Penner, R. L. (Univ. of Toronto). Lett. Nuovo Cim.; 8: No. 5, 273-277(29 Sep 1973).

A new class of weak interaction theories where the primary boson is a neutral vector boson is examined. An example of a spontaneously broken gauge theory of this class is constructed. (LBS)

28418 ANOMALOUS INTERACTIONS OF MUONS AND HEAVY μ-MESOATOMS. Zakharov, V. I.; Shifman, M. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 162-166(Jul 1973). (In Russian).

Based on the data on the lead μ-mesoatom a limit for the hypothetical scalar muon–hadron interaction constant is obtained with account of the nuclear form factor. (auth)

28419 INTERMEDIATE-PARTICLE PRODUCTION IN THE RENORMALIZABLE THEORY OF THE WEAK INTERACTION. Asratyan, A. E.; Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 167-173(Jul 1973). (In Russian).

In framework of the renormalizable model of weak interactions, the cross sections are calculated for lepton and hadron–lepton processes with production of the heavy intermediate bosons and leptons. The processes may be seen in experiments with colliding electron–positron and electron–proton beams and in neutrino experiments. (auth)

28420 SOME PHYSICAL CONSEQUENCES FROM A NONLOCAL QUANTUM THEORY OF WEAK INTERACTION. Alebastrov, V. A.; Efimov, G. V.; Sel'tser, Sh. Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 210-220(Jul 1973). (In Russian).

In framework of a nonlocal theory of electromagnetic and weak interactions the $\nu\nu$ interactions and the neutrino electromagnetic form factor are studied. Two models of the weak interactions are considered: the four-fermion one, as well as the model with the W boson. Some speculations on the origin of the muon–electron mass difference are presented. (auth)

Strong (General)

Refer also to abstracts 28008 and 28528.

28421 (ANL/HEP-7330) EXPERIMENTAL SUPPRESSIONS OF RESONANCE COUPLINGS AS GAUGE-LIKE CONDITIONS FROM DUAL RESONANCE MODELS. Odorico, R. (Argonne National Lab., Ill.). 1973. 87p. Dep. NTIS $6.50.

The observed phenomenon of dynamical suppression of a number of resonance couplings (f'(1520) $\pi\pi$, K** (1420) Kη, etc.), new instances of which keep appearing as data accumulate, is discussed. A few of such effects have been conventionally understood in terms of the quark model, which is, however, inadequate to account for all of them. A specific dual resonance model, which is suggested by the approximate linearity in the (s, t, u) plane observed for the zero trajectories of certain two-body amplitudes is considered. Relevant experimental evidence concerning zero behavior has been already discussed elsewhere; a short and updated review of it is presented. It is shown that such a dual model predicts in a natural way many of the observed coupling suppressions, and possibly — once generalized — all of them. It also accounts partially, in an analogous manner, for the decoupling of exotic resonances. The way in which the dual constraints of the model and the resonance decouplings are interrelated exhibits a structural similarity with the well known interconnection between charge conservation and decoupling of longitudinal photons in electromagnetic interactions. The model is supposed to apply in its present form only to amplitudes in which linearity of zeros is observed, but there are elements to argue that dual constraints of the same nature are active in any hadronic amplitude. Central in obtaining the results is the interplay of the dual model and unitary symmetries, which is much stronger than in conventional dual models, where such symmetries intervene only externally through Chan–Paton factors. (auth)

28422 (DESY-73/20) DYNAMICAL PROBLEMS OF THE RELATIVISTIC QUARK MODEL. Boehm, M.; Joos, H.; Krammer, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1973. 82p. Dep. NTIS (U.S. Sales Only) $6.25.

The discussion covers the existence of quarks, a dynamical pattern of the relativistic quark model, heavy quarks and strong binding, the fermion–antifermion Bethe–Salpeter equation, mass spectrum and wave functions of mesons in the relativistic quark model,

current matrix elements, hadronic vertices, baryons, and meson scattering. (JFP)

28423 (IC-73-29) THEORY OF THE DUAL RESONANCE MODEL AND OF THE QUANTUM RELATIVISTIC STRING. Rebbi, C. (International Center for Theoretical Physics, Trieste (Italy)). Apr 1973. 66p. Dep. NTIS (U.S. Sales Only) $5.50.

Lectures are given on the detailed analysis of the algebraic properties and physical interpretation of the conventional dual resonance model. The Koba–Nielsen form of the conventional dual resonance model, factorization, physical and spurious states and generalized Ward identities, quantum mechanics of a relativistic massless string, and transverse states and the no ghost theorem. (JFP)

28424 (JU-RR-73/11) NOVA MODEL FOR DIFFRACTION DISSOCIATION WITH LONGITUDINALLY DECAYING NOVAS. Kajantie, K.; Ruuskanen, P. V. (Jyvaskyla Univ. (Finland). Dept. of Physics). May 1973. 21p. (CONF-730334-7). Dep. NTIS (U.S. Sales Only) $3.25.

From 8th Recontre de Moriond conference; Meribel-les Allues, France (4 Mar 1973).

A model for diffractive events in high energy hadron collisions is constructed and the charged particle multiplicity distribution following from this is calculated. The model is a nova-type model in which the excitation spectrum of the nova behaves like M^{-2} for large M and in which the nova decays longitudinally in its rest frame. These features are motivated by simple multiperipheral arguments. Implications of the results on multiperipheral and uncorrelated jet model descriptions of the pionization component are discussed. (auth)

28425 CONSISTENCY CONDITIONS FOR $N\bar{N} \to \pi\pi$ HELICITY AMPLITUDES. Epstein, G. N.; McKellar, B. H. J. (Univ. of Melbourne, Parkville, Australia). Lett. Nuovo Cim.; 8: No. 3, 177-181(15 Sep 1973).

Consistency conditions are derived on the helicity amplitudes for $N\bar{N} \to \pi\pi$ interactions which provide an independent check on published calculations and can be used as a basis for improved methods of calculations. These consistency conditions are applied as a check on previous helicity amplitude calculations, and as a constraint in Omnes dispersion relations to accurately determine both the entire f_+^0 amplitude and the p-wave amplitudes f_-^1, Γ_2 at resonance. Also the efficacy of using non-Born Omnes dispersion relations for determining helicity amplitudes is shown. (JFP)

28426 SPECTRUM OF π-MESONS GENERATED IN DUAL FIREBALL DECAYS. Makarov, V. I.; Miranskii, V. A.; Shelest, V. P.; Zinovjev, G. M. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 8: No. 3, 151-155(15 Sep 1973).

Fireball decay, which has certain G parity, is considered for high energy strong interactions. The resonance decay with mass M_1 into another resonance mass M_2 and a pion is discussed. It is found that the dual-fireball width, conditioned by their decays into another fireball and a pion, is constant. (JFP)

28427 TRIPLE POMERON VERTEX AND COMPLEX POMERON TRAJECTORIES. Oehme, R. (Univ. of Chicago). Phys. Lett.; 45B: No. 3, 279-281(23 Jul 1973).

Complex Pomeron trajectories can give rise to $(\log s)^2$-shrinkage of the diffraction peak. With factorization, one obtains consistency with the energy momentum sum rule in the triple-Regge limit provided the total cross section approaches a constant or increases less fast than $(\log s)^{\frac{1}{2}}$. (auth)

28428 VECTOR AND AXIAL CHARGES OF THE HADRONS. Buccella, F. (Univ., Rome); Nicolo, F.; Pugliese, A. Riv. Nuovo Cim.; 3: No. 2, 127-145(1973).

The classification of hadron states is discussed. In the first section isospin, SU(3), and the Cabibbo theory of semileptonic decays are discussed. The second section concerns SU(6) and its connection to chiral $SU(3) \times SU(3)$. In the third section the saturation of chiral algebra is studied to find a suitable form for the mixing operator. The fourth section describes the modification of the weak charges due to the SU(3) symmetry breaking. Finally some attempts to better determine the mixing operator are described and an outlook of further research in the field is given. (LBS)

28429 MODELS FOR HIGH ENERGY PRODUCTION PROCESSES: A CRITICAL DISCUSSION. Bassetto, A. (Univ., Padua). Riv. Nuovo Cim.; 3: No. 2, 119-126(1973).

The properties of the various models used to analyze multiple production processes are discussed. The models are divided into two classes: those in which the limitation is explicitly imposed (multiperipheral models, uncorrelated jet model, diffractive excitation models); and those in which the limitation is a deep consequence of a bootstrap hypothesis (dual model, thermodynamic model). The difficulties and advantages of the models are also discussed. (LBS)

28430 THEORY OF DUAL-RESONANCE MODELS. Rebbi, C. (CERN, Geneva). Riv. Nuovo Cim.; 3: No. 2, 194-202(1973).

A review is given of the theory of dual resonance models. Consideration is first given to the nature of the spectrum of excitations in the conventional dual-resonance model. The no-ghost theorem is then considered. A brief review is then given of some recent contributions to the theory of dual-resonance models. (LBS)

28431 DUALITY AND MULTIPARTICLE PRODUCTION. Gorson, E. M. Montreal; McGill Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Some properties and applications of two models for multiparticle production are studied. The first is the dual resonance model. The operator formalism in this model is extended to the case of Regge trajectories with unequal intercepts in all channels. Factorization of the amplitude is imposed with the result that a specific parameterization of the Regge trajectories is obtained and a quark picture of the dual model emerges. The questions of ghost compensation and SU(1,1) symmetry of the amplitude in the unequal intercept case are examined. The second model considered is the diffractive excitation model. The factors that determine the shapes of the inclusive single particle spectra in this model are examined in detail, with emphasis on correlations between the longitudinal and transverse momenta of the produced particles. Calculations are presented for a wide variety of reactions and the results are found to compare well with experiment, particularly since no free parameters are used. (auth)

28432 POMERANCHUK THEOREMS FOR PRODUCTION PROCESSES. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 8: No. 4, 256-258(22 Sep 1973).

It is shown that two-to-three scattering processes obey Pomeranchuk-type theorems for the differential cross sections and polarizations. (LBS)

28433 CHIRALITY AND REGULARIZATION IN NON-POLYNOMIAL STRONG INTERACTIONS. Keck, B. W.; Taylor, J. G. (King's Coll., London). J. Phys., A (London); 6: No. 9, 1403-1419(Sep 1973).

The problem of regularization of the nonlinear σ model in a fashion consistent with the formal chiral invariance possessed by the nonpolynomial Lagrangian is discussed. The single loop contributions to the Ward–Takahashi identities are only chirally invariant under special conditions on the extra constants arising from a general regularization process which are defined; these conditions can be satisfied in both the massive and massless cases. A natural method of regularization is given which, however, violates chirality, and it is indicated that, in particular, superpropagator methods for discussing this or similar theories must be treated with great care to avoid violation of Ward–Takahashi identities. (auth

28434 HADRON PHYSICS AT VERY HIGH ENERGIES. Horn, D.; Zachariasen, F. Frontiers in Physics. Reading, MA; W. A. Benjamin, Inc. (1973). 393p. $9.50.

The review covers phenomenology, Regge pole analysis, and field theoretical, multiperipheral, and other models. (JFP)

28435 EFFECT OF NUCLEONS IN HIGH ENERGY COLLISIONS. Ginzburg, I. F. (Inst. of Mathematics, Moscow). Yadern. Fiz.; 18: No. 2, 420-424(Aug 1973). (In Russian).

On basis of the γ^5 theory (with nucleon as an elementary particle) an increase of the number of produced nucleons up to an asymptotic value is predicted. The obtained estimates are close to the experimental results. (auth)

28436 MULTIPERIPHERAL THEORY OF PARTICLE INTERACTIONS AT HIGH ENERGIES. πN and NN Interactions. Volkov, E. I.; Dremin, I. M.; Dunaevskii, A. M.; Roizen, I. I.; Chernavskii, D. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 2, 437-446(Aug 1973). (In Russian).

Based on the results obtained for the $\pi\pi$ interaction in the first part of this work the πN and NN interactions are considered at intermediate and high energies. Principal properties of the total cross sections, elastic and charge-exchange amplitudes near $t = 0$ are obtained. Some distributions for the inelastic processes at $E_L = 70$ GeV are calculated. (auth)

28437 EXPLORATORY DIP SYSTEMATICS IN ELASTIC SCATTERING. Tran Thanh Van, J. (Laboratoire de Physique Theorique et des Particules Elementaires, Orsay, France). Lett. Nuovo Cim.; 8: No. 5, 289-294(29 Sep 1973).

It is shown that regularity in the dip positions of the elastic

differential cross sections is observed when the variable $x = -\sigma_{tot}^2 t$ is used, using the absorption model as a guide. (LBS)

28438 USE OF DENSITY CORRELATIONS IN TESTING MODELS OF PARTICLE PRODUCTION. Koba, Z. (CERN, Geneva); Weingarten, D. Lett. Nuovo Cim.; 8: No. 5, 303-309 (29 Sep 1973).

A description of multiparticle final states was previously constructed by using a set of quantities called density moments, and from these another collection of functions called density correlations was defined. Alternative definitions of the first few density correlations are given; various ways of using integrals of these functions to test models of particle production are then considered. Normalized integrals of density correlations are used to test the predictions of a version of the two-component model and the predictions of early multiplicity scaling for the distribution of charged particles produced in proton–proton collisions. (LBS)

28439 SCALING FOR HADRONIC FORM FACTORS AND COMPOSITE MODEL OF HADRONS. Lalovic, D.; Pomorisac, B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Lett. Nuovo Cim.; 8: No. 5, 313-317(29 Sep 1973).

It is shown that the scaling law for the form factors of the hadronic transition $N \rightarrow N^*$ can be derived from a composite model of hadrons. (LBS)

28440 STATISTICAL DUALITY. Weiner, R. M. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 8: No. 5, 281-284(29 Sep 1973).

A model is presented for a class of reactions in which the t-dependence in the physical region of the differential cross section is (up to a power) the same as the asymptotic s-dependence of the cross section and is completely determined by it. The model is based on a statistical approach. A consequence of statistical duality is a break in $d\sigma/dt$ for the reaction $\pi^- p \rightarrow \rho^0 N$ and the prediction that the decrease with t of $d\sigma/dt$ at large t is slower than at small t. (LBS)

28441 APPROXIMATE ACCOUNT OF ABSORPTIVE CORRECTIONS TO BINARY HADRONIC REACTIONS AND THE COULOMB PHOTOPRODUCTION. Andreev, I. V.; Ostapchuk, A. Ya. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 1, 182-189(Jul 1973). (In Russian).

Approximate expressions for account of the absorptive corrections to inelastic binary hadronic reactions are given describing the rescattering in the eikonal approach. The absorptive corrections to the Primakoff effect on protons are calculated and a simple analytical formula for these corrections is presented. (auth)

28442 CORRELATION PARAMETERS f_2, f_3, AND f_4 FOR THE MULTIPLICITY DISTRIBUTION IN HIGH ENERGY INTERACTIONS. Minakata, H. (Hiroshima Univ.); Tati, T.; Yokoyama, K. I. Progr. Theor. Phys. (Kyoto); 49: No. 3, 1060-1062(Mar 1973).

Correlation parameters f_2, f_3, and f_4 for negative pions are computed on the basis of a scaled Poisson distribution and are compared with values calculated from accelerator and cosmic ray data for $\pi^+ p$ and pp interactions. (LBS)

Strong (Baryon No. = 0)

Refer also to abstracts 28368 and 28515.

28443 (EFI-TF-3(71)) $X^0(960)$-MESON SPIN-PARITY DETERMINATION FROM X^0 DECAY. Zaslavskii, A. N.; Solakhyan, V. P. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1971. 11p. (In Russian). INIS.

It was shown that the measurement of the polarization of γ quanta in the decay $X^0 \rightarrow \rho^0 S^+ S^- \gamma$ makes it possible to make a selection between two hypotheses, existing at present, on the spin-parity of X (960) mesons: $J^P(X^0) = 0^-$ and $J^P(X^0) = 2^-$. (tr-auth)

28444 HARD-PION AMPLITUDES AT THRESHOLD WITHOUT CURRENT ALGEBRA. Gensini, P. (Univ., Lecce, Italy). Lett. Nuovo Cim.; 8: No. 3, 171-176(15 Sep 1973).

A study is made of claims that the rigorous results from axiomatic field theory could force the low energy parameters of pion–pion scattering to lie in domains close to the values derived from current algebra by Weinberg. The question of how large has the amount of phenomenological input to be in order to reproduce Weinberg's results is examined. Also a phenomenological link between S_2- and P-wave scattering lengths which was derived exploiting the analyticity properties of a forward crossing-even amplitude is considered. (JFP)

28445 TRIPLE-POMERON VERTEX WITHIN THE MULTIPERIPHERAL MODEL. Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Lett. Nuovo Cim.; 8: No. 3, 149-150(15 Sep 1973).

Two schemes for deriving the value of the triple-pomeron vertex from the multiperipheral theory by considering the double-diffraction dissociation process can be easily interrelated, if one takes into account that the iterations of all nonet exchange graphs must coincide with the iterations of the sum of two-pion resonances and the high energy inelastic pion–pion tail in the one-pion exchange scheme if the Regge singularities are the same for both approaches. It is found that the triple-pomeron vertex is small. (JFP)

28446 ADLER CONDITION AND HIGH ENERGY BOUNDS OF MASSLESS PARTICLE TOTAL CROSS SECTIONS. Auerbach, S. P.; Pennington, M. R.; Rosenzweig, C. (Univ. of California, Berkeley). Phys. Lett.; 45B: No. 3, 275-278(23 Jul 1973).

The problem of deriving high energy bounds on total cross sections for processes in which massless particles can participate is studied. One can prove such bounds given the following assumptions: Mandelstam analyticity, polynomial boundedness, smoothness, Adler's condition for massless pions or analogous conditions for other massless particles such as neutrinos. The resulting bound is that total cross sections are constant up to powers of logarithms of the energy. (auth)

28447 DUAL, CROSSING SYMMETRIC REPRESENTATIONS WITH FINITE WIDTH RESONANCES. Gaskell, R. W. Montreal; McGill Univ. (1972). National Library of Canada, Ottawa. Thesis (Ph. D.).

Dual, crossing symmetric representations with resonances having finite width are proposed and developed in detail. In particular, the asymptotic behavior over the whole complex energy plane is studied and it is shown that certain recently proposed scattering amplitudes lead to non-Regge contributions in most (or all) of the physically important regions of the kinematical variables. Conditions for Regge behavior are developed, a class of models satisfying these conditions (along with other physically important requirements) is presented and a simple model obeying them is studied in detail. A number of physical applications are also presented, including an explanation of the Dalitz plot distribution for $\bar{p}n \rightarrow 3\pi$, the behavior of the most important $\pi\pi$ phase shifts and a determination of the $\pi\pi$ S-wave scattering lengths. (auth)

28448 TWO BODY MESONIC NUCLEON–ANTINUCLEON ANNIHILATIONS. Kerbikov, B. O. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 46B: No. 2, 245-248(17 Sep 1973).

It has been shown that significant difference between cross section for the reaction $\bar{p}p \rightarrow K_S^0 K_S^0$ in hydrogen and in deuterium as well as the suppression of this reaction in hydrogen relative to the process $\bar{p}p \rightarrow K_S^0 K_L^0$ may be explained by interference of two quasi-nuclear mesons. Existence of these mesons results in large cross sections for the processes $\bar{p}p \rightarrow 2\pi^0$ and $\bar{p}p \rightarrow \pi^0\eta^0$. (auth)

28449 PHASE COHERENCE OF P-WAVE SINGLE PION PRODUCTION AMPLITUDES. Gutay, L. J. (Purdue Univ., Lafayette, IN); Vasavada, K. V. Phys. Lett.; 46B: No. 1, 88-90(3 Sep 1973).

Recently it has been claimed that the coherent phase hypothesis of the P-wave amplitudes in ρ^0 production is wrong. It is shown that this conclusion is not valid. (auth)

28450 PI-MUONIUM: A DETERMINATION OF THE PION CHARGE RADIUS. Uzi Bar-Gadda (Stanford Univ., CA); Cho, C. F. Phys. Lett.; 46B: No. 1, 95-98(3 Sep 1973).

The $2S_{\frac{1}{2}} - 2P_{\frac{1}{2}}$ energy level shift of the π-μ atom is studied. It is shown that an experimental determination of the $2S_{\frac{1}{2}} - 2P_{\frac{1}{2}}$ energy level shift accurate to one part per thousand can provide an independent determination of the pion charge radius. (auth)

28451 ASYMPTOTICS OF CROSS SECTION WITH T = 1 IN MULTIPERIPHERAL MODEL. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 2, 431-436(Aug 1973). (In Russian).

It is shown that the multiperipheral models providing a constant total cross section explain reasonably also the asymptotics of the T = 1 $\pi\pi$ scattering. (auth)

28452 ZERO CONTOURS AND ρ DOMINANCE IN LOW ENERGY $\pi-\pi$ SCATTERING. Arneodo, A. (Univ., Nice); Guerin, F.; Donohue, J. T. Nuovo Cim., 17A: No. 2, 329-342(21 Sep 1973).

The paths of nearby zeros of the low-energy $\pi-\pi$ scattering amplitudes A and A^2 are examined in a simple ρ dominance model, where it is found that the roles of PCAC zero, ρ Legendre zero and double-pole–killing zero are filled by one closed curve, a circle in the (s,t,u)-plane. The behavior of this zero contour is studied when an approximate unitarization is performed, leading to a realistic $\pi-\pi$ amplitude, and it is found that large portions of the contour are only slightly changed. (auth)

28453 SCALE DIMENSIONALITY OF THE AXIAL CURRENT AND THE $\sigma\pi\pi$ VERTEX. Dao Vong Duc (Joint Inst. for Nuclear

Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 190-195(Jul 1973). (In Russian).

Scale dimensionality of the time component of the axial current is calculated. The $\sigma\pi\pi$ vertex is considered based on the scale transformation of the current. The obtained expression is in reasonable agreement with the experiment. (auth)

28454 LOWER BOUND FOR THE NUMBER OF PARTIAL WAVES NECESSARY FOR EXPERIMENTAL ANALYSIS. Uchiyama, T. (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1042-1043(Mar 1973).

Lower bounds are given for the number of partial waves necessary for the experimental analysis of $\pi^{\pm}$p, $K^{\pm}$p, $\bar{p}$p, and pp interactions. (LBS)

Strong (Baryon No. = 1)

Refer also to abstracts 28338 and 28509.

28455 (RL-73-13) EXTRAPOLATION OF $\pi-$N AMPLITUDE TO THE $\pi-\pi$ CUT. Chao, Y. A.; Zia, R. K. P. (Rutherford High Energy Lab., Chilton (England)). Apr 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

The problem of extrapolating, at a fixed energy, a scattering amplitude determined from phase-shift analysis onto the t- or u-channel cuts is studied in detail by following Cutkosky's work on reproducing kernels. The Riesz representation theorem is used to estimate and minimize the bounds on extrapolation errors. Percentage errors of extrapolating the present six-partial-wave π-N amplitude to various points beyond the two pion cut are calculated explicitly. These errors arise from extrapolation only and are independent of the empirical values of the phase-shifts. (auth)

28456 POLARIZED NEUTRON BEAMS FROM SPIN TAGGING. Bunce, G. (CEN, Saclay, France). Lett. Nuovo Cim.; 8: No. 3, 156-158(15 Sep 1973).

A technique is presented which replaces the double-scattering polarization experiment which is difficult for neutrons, with single neutron scatter and a proton analysis. The neutron polarization achieved is a factor of two to three lower than if double scattering were feasible, and the flux is about 10^5 per second. Also this provides an interesting test of the multiple-scattering model in deuteron-proton scattering. (JFP)

28457 DUALITY AND VACUUM REGGE SINGULARITIES WITH ZERO INTERCEPT. Ferrari, E.; Lusignoli, M. (Univ., Rome). Lett. Nuovo Cim.; 8: No. 4, 225-231(22 Sep 1973).

Evidence is presented, based on duality arguments, for the presence of an additional vacuum singularity with $\alpha(0) \simeq 0$ in forward TN scattering. In particular it is shown that a real constant must be added to the P and P' contributions in order to have an asymptotic behavior of the amplitude consistent with the experimental data. (LBS)

28458 NEW ESTIMATE OF THE NUCLEON SIGMA-TERMS. Scadron, M. D.; Thebaud, L. R. (Univ. of Arizona, Tucson). Phys. Lett.; 46B: No. 2, 257-260(17 Sep 1973).

From low energy πN and KN data it is found that $\sigma(\pi N) \approx$ 70 MeV and $(u_0/u_\beta)_N \approx 1$. (auth)

28459 NEUTRAL-CHARGED PARTICLE CORRELATIONS IN HIGH ENERGY COLLISIONS. Dao, F. T.; Whitmore, J. (National Accelerator Lab., Batavia, IL). Phys. Lett.; 46B: No. 2, 252-256(17 Sep 1973).

Recent experiments at Serpukhov, NAL, and CERN indicate a strong correlation between neutral and charged pions produced in high energy collisions, in contrast to the trend shown by data at lower energies. This study of the energy and charge dependence of these correlations indicates that they do not depend upon the initial state particles and that they are in reasonable agreement with the critical fluid gas model. These high energy correlation data are also studied in terms of a semi-inclusive Koba-Nielsen-Olesen scaling relation. (auth)

28460 DISPERSIVE PART OF THE BOX DIAGRAM AMPLITUDE. Singh, C. P. (Banaras Hindu Univ., India). J. Phys., A (London); 6: No. 9, L130-L132(Sep 1973).

A method to evaluate the dispersive part of the box diagram amplitude is given. The dispersive part thus obtained is shown to be smaller than the absorptive part in the energy region from an incident meson momentum of 1.5 to a momentum of 4 GeV/c. (auth)

28461 PRODUCTION OF HIGHER RESONANCES IN THE QUARK MODEL. Savoy, C. A. (Univ., Geneva). Lett. Nuovo Cim.; 8: No. 2, 79-84(8 Sep 1973).

The quark model is used to apply the mixing idea to inelastic scattering, and the production of L = 1 mesons is expressed in terms of the cross sections for the production of L = 0 mesons. Amplitudes for the processes πp and π^-p are found. (JFP)

28462 BETHE PHASE-SHIFT AND MEASUREMENT OF THE Ref/Imf RATIO IN HIGH ENERGY SCATTERING ON PROTONS AND DEUTERONS. Kopeliovich, V. B. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 2, 406-414(Aug 1973). (In Russian).

It is shown that uncertainties in the Bethe phase shift ϕ_B due to a contribution from inelastic intermediate states decrease logarithmically with the energy. The quantity $\eta^+ = \mathrm{Ref}_s^+/\mathrm{Imf}_s^+$ for the crossing symmetrical particle (antiparticle)-proton scattering amplitude may be determined, in principal, with accuracy α in $s(\sigma^- - \sigma^+)/(\sigma^- + \sigma^+)$, $\alpha\eta^+$, where $\alpha = 1/137$, $\sigma^\pm$ is the total particle (antiparticle) cross section, measuring the difference of the differential cross sections for particles and antiparticles. In the difference the uncertainties in the Bethe phase shift are, mainly, cancelled out. In case of $\pi^\pm$d scattering the quantities $\eta^{\pi d}$ and $\phi_B^{\pi d}$ may be determined with the indicated accuracy. As the uncertainties in $\phi_B^{\pi d}$ are directly expressed in terms of the uncertainties in $\phi_B^{\pi N}$, measurement of the difference of the differential, as well as total, $\pi^\pm$d scattering cross sections may be a way to determine a contribution to the Bethe phase shift for the πN scattering from inelastic intermediate states. (auth)

28463 QUARK PARTON MODEL AND A POSSIBILITY TO DETECT THE W BOSON IN HIGH-ENERGY NUCLEON-NUCLEON COLLISIONS. Golubkov, Yu. A.; Ivanilov, A. A.; Nikitin, Yu. P.; Rozhnov, G. V. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 18: No. 2, 393-402(Aug 1973). (In Russian).

A qualitative analysis of the lepton spectra produced in the reaction $p + N \rightarrow W(\rightarrow l + \nu_l) + (\text{hadrons})$ is fulfilled. It is shown that there is a correlation between the momentum and angle of the lepton emission and the W-boson mass, that does not depend on the interaction dynamics. The detected correlation enables one to measure the W-boson mass by means of the positions of the maxima in the lepton energy spectra, emitted under a fixed angle in lab. system. The results are supported by concrete calculations of differential and total cross sections for $l^\pm$ leptons produced in the reactions $p + N \rightarrow W(\rightarrow l + \nu_l) + (\text{hadrons})$ and $p + N \rightarrow$ "γ" $(\rightarrow l^+ + l^-) + (\text{hadrons})$ on basis of the quark parton model. (auth)

28464 ANALYSIS OF THE REACTION $\pi^-N(A) \rightarrow 2\pi^-\pi^+N(A^*)$ IN THE MOMENTUM SPACE. Vasil'kova, A. D.; Gornov, M. G.; Levina, V. I.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 18: No. 2, 369-373(Aug 1973). (In Russian).

Spectra of longitudinal and transversal components of the secondary pion momenta in the reaction $\pi^-N(A) \rightarrow 2\pi^-\pi^+N(A^*)$ are investigated at the incident momentum of ~3.9 GeV/c. It is shown that the longitudinal component distribution in the positive region outside the leader domain may be described by means of the expression $dN/dx \sim \exp(-Ax)$, where x is the Feynman variable, A is a constant. There are some indications too that A does not depend on the target and on value of the incident energy. The analysis shows an essential overlap of regions on the Van Hove diagram corresponding to various Feynman graphs. (auth)

28465 LIGHT CONE SINGULARITIES IN THE HIGH ENERGY BACKWARD SCATTERING. Raval, V. M.; Ramachandran, R. (Indian Inst. of Tech., Kanpur). Phys. Lett.; 46B: No. 1, 91-94 (3 Sep 1973).

An attempt is made to relate the high energy backward scattering data for $\pi p \rightarrow \pi p$ process to the dominance of the light cone singularities in the product of the pion source currents. The quantity $s^3\, d\sigma/dt$, plotted as a function of scattering angle, appears to follow a universal curve in this region and suggests the scale dimension two for the pion source current. (auth)

28466 MESON-BARYON ELASTIC POLARIZATION AND THE REAL PART OF THE NONFLIP AMPLITUDE. Chiu, C. B. (Univ. of Texas, Austin); Wada, W. W. Nuovo Cim.; 17A: No. 2, 355-365(21 Sep 1973).

The strong central absorption prescription for the nondiffractive helicity-nonflip elastic two-body scattering amplitude that has recently been proposed is briefly discussed, and the experimental indications for this in the crossing-even πp and K^-p scattering amplitudes are presented. The strong and weak versions of the prescription are also presented. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 28653, 28911, 28926, and 28980.

28467 (ORO-4317-26) REMARKS ON WAVE FUNCTION MODELS OF THE HALF-SHELL T MATRIX FOR TWO NUCLEONS.

Technical Report No. 74-010. Picker, H. S.; Redish, E. F.; Stephenson, G. J. Jr. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1973. 14p. Dep. NTIS $3.00.

The numerical accuracy of an approximation used in the wave function model of the two nucleon interaction is discussed. In addition, the energy dependence of the upper and lower bounds on the parameter used to mock up the off-shell uncertainty is considered. (auth)

28468 (RLO-1388-660) DESCRIPTION OF THE TRIPLE REGGE REGION WITH A VERY LARGE PPP COUPLING AND A BARE POMERON. Dash, J. W. (Argonne National Lab., Ill.; Washington Univ., Seattle. Dept. of Physics). Jul 1973. 26p. (CONF-730837-1). Dep. NTIS $3.50.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

A description of data in the triple Regge region up to ISR energies is proposed. The description utilizes a very large PPP coupling g_P and assumes that the "bare" or "unrenormalized" Pomeron controls the region near x = 1. The "bare" Pomeron intercept is $\tilde{\alpha}_0 = 0.85$. One secondary term is employed to extend the description to x = 0.7. This term is chosen to be of the form $\pi\pi P$. A modified ABFST model is used to roughly constrain g_P and $\tilde{\alpha}_0$. The number of unconstrained parameters otherwise is one. Other phenomenological applications utilizing the bare Pomeron as the definition of diffraction at intermediate energies are discussed, and the total cross section with and without diffraction is discussed in the context of the ABFST model. (auth)

28469 (RLO-2041-92) PIONIZATION MODEL FOR HIGH ENERGY COLLISIONS. Hwa, R. C.; Lam, C. S. (Oregon Univ., Eugene. Inst. of Theoretical Science). 1973. Contract AT(45-1)-2230. 10p. Dep. NTIS $3.00.

Using the proton spectrum as a guide, a model was constructed which amalgamates the diffractive and pionization processes. It gives rise to a central flat plateau for the pion spectrum, $\sigma_T \sim \ln s$, $\langle n \rangle \sim \ln s$, $f_2 \sim (\ln s)^2$, and a Pomeron slope ranging from 0.1 to 0.6 GeV^{-2}. (auth)

28470 TAIL OF THE SPECTATOR IN $K^+d \rightarrow K^0pp$. Alberi, G. (Univ., Trieste, Italy); Gregorio, M. A.; Thome, Z. D. Phys. Lett., 45B: No. 5, 490-492(20 Aug 1973).

The large values of the spectator momentum distribution for large values of this variable are explained with a model based on final-state interaction of the two emerging protons. A comparison with recent experimental data is presented. (auth)

28471 PP SCATTERING AT ISR ENERGIES AND S-CHANNEL UNITARITY. Antoniou, N. G.; Kouris, C. B.; Papaioannou, G. M. (Democritos Nuclear Research Center, Aghia Paraskevi Attikis, Greece). Lett. Nuovo Cim.; 8: No. 3, 159-165(15 Sep 1973).

Using s-channel unitarity and a simple model for the overlap function it is shown that the recent ISR data on elastic pp scattering can easily be understood in terms of shadow scattering with complete absorption of the incident S wave. It is pointed out that the ISR results are consistent with a diffractive model based on s-channel unitarity under the assumption that the asymptotic region is reached. It is found that the pomeron in the model used is a moving dipole with intercept one, and conclusions can be drawn on the slope of the Pomeranchuk singularity. (JFP)

28472 THREE-REGGEON DESCRIPTION OF INCLUSIVE PROTON SPECTRA. Kaidalov, A. B.; Pirogov, Yu. F.; Ter Isaakyan, N. L.; Khoze, V. A. (Inst. of Nuclear Physics, Leningrad). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 440-442 (5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 626-629(5 Jun 1973).

It is shown that a simultaneous analysis of the data for $pp \rightarrow pX$ hadronic spectra near the kinematic boundary within the framework of the three-reggeon scheme leads to an entirely different relation between the vertices, namely, to appreciable PPP and RRR, the presence of RRP, and the smallness or nonexistence of PPR (where P is the Pomeranchuk pole and R stands for the secondary trajectories P', ρ, ω, A_2, etc.). Some estimates are given of the absolute scale of the obtained three-pomeron vertex. (JFP)

28473 TWO NUCLEON INTERACTION AND THE COHEN APPROXIMATION. Noble, C. J.; Richards, K. C. (Bartol Research Foundation of the Franklin Inst., Swarthmore, Pa.). Phys. Lett.; 45B: No. 4, 315-317(6 Aug 1973).

The Cohen approximation to the scalar Bethe-Salpeter equation is used to study the exchange of mesons between nucleons. Numerically, the Cohen approximation is more accurate than the Blankenbecler-Sugar approximation in all partial waves. (auth)

28474 DUALITY AND PROTON-PROTON SCATTERING AT ALL ANGLES. Coon, D. D. (Stanford Linear Accelerator Center, CA); Sukhatme, U. P.; Tran Thanh Van, J. Phys. Lett.; 45B: No. 3, 298-291(23 Jul 1973).

A very good description of all available large angle pp elastic scattering data is obtained using a dual model with logarithmic trajectories. The fit strongly suggests that the dual amplitude is responsible for filling in a pronounced dip produced by the Pomeranchuk singularity. This new explanation of the shoulder in pp data survives the test of an enormous extrapolation from $s \approx 20$ $(GeV/c)^2$ to $s \approx 2600$ $(GeV/c)^2$ and successfully predicts the depth of the dip at $t \approx -1.3$ $(GeV/c)^2$ in the recent ISR data. The addition of an eikonalized Pomeron exchange term to the dual amplitude results in an excellent description of pp scattering data at all angles. (auth)

28475 LINK BETWEEN THE NP CHARGE EXCHANGE FORWARD SPIKE AND THE GOLDBERBER-TREIMAN RELATION. Diu, B. (Laboratoire de Physique Theorique et des Hautes Energies, Paris). Lett. Nuovo Cim.; 8: No. 3, 145-148(15 Sep 1973).

It is found that the analogy between the Goldberger-Treiman relation and the explanation of the np charge exchange forward spike is not a mere coincidence, but reflects the same basic mechanism: the sigma model, which incorporated the Goldberger-Treiman relation in a simple way also gives the correct values for the background amplitudes in no charge exchange provided the physical mass of the sigma particle (which originally appears as a free parameter in the model) is twice the nucleon mass. (JFP)

28476 QUESTIONS ON THE CONVERGENCE OF A SERIES OF DIAGRAMS FOR THE AMPLITUDE OF THE FORWARD ELASTIC SCATTERING OF NUCLEONS ON DEUTERONS AT HIGH ENERGIES. Gaivoronskaya, T. V.; Popova, A. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1120-1124(May 1973). (In Russian).

It is known that, if the process of elastic scattering of nucleons on deuterons is represented as a quantum-mechanical three-body problem, then the amplitude of the reaction can be set up in conformity to an infinite series of diagrams. The contribution of diagrams with two closed contours is calculated. (1 figure) (JSR)

28477 PION EXCHANGE AND MISSING-MASS SPECTRA NEAR THE PHASE-SPACE BOUNDARY. Pham Xuan Yem (Institut de Physique Nucleaire, Paris). Lett. Nuovo Cim.; 8: No. 4, 266-272(22 Sep 1973).

The contribution of pion exchange to the cross section for $p + p \rightarrow p +$ anything is calculated. It is shown that the contribution is kinematically enhanced in the phase-space boundary (t very small, M^2 and S/M^2 large, M = missing mass) where the triple-Regge formula is generally used. It is pointed out that the dip (and its movement with energy) and the raising shape of the missing mass spectra are two essential features of pion exchange. (LBS)

28478 PRONG CROSS SECTIONS FROM A REALISTIC TWO-COMPONENT MODEL. Roberts, R. G.; Roy, D. P. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 46B: No. 2, 201-206(17 Sep 1973).

The inclusive $pp \rightarrow pX$ data, supporting a large triple Pomeron contribution, is invoked to predict the diffractive multiplicity distributions. Poisson decay is assumed for the excited cluster. The predicted diffractive prong cross sections agree with the empirical estimates at 200 GeV/c and suggest a significant broadening at 1500 GeV/c (giving a rise in $\sigma_T \sim 2.5$ mb). Consequently the full prong distribution should develop no dip. (auth)

28479 ISR ELASTIC PROTON-PROTON SCATTERING DATA AND GRIBOV'S REGGEON CALCULUS. Pajares, C.; Shiff, D. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Lett. Nuovo Cim.; 8: No. 4, 237-243(22 Sep 1973).

Various features of the ISR elastic proton-proton scattering data are re-examined within the framework of Gribov's reggeon calculus, in terms of a minimum parametrization consistent with the requirements of the theory. It is concluded from two fits that the recent ISR data for the total and differential cross sections are well described by the Gribov calculus. (LBS)

28480 INEQUALITIES BASED ON UNITARITY AND DUALITY. Lee, H. (Northeastern Univ., Boston). Phys. Lett.; 46B: No. 1, 117-120(3 Sep 1973).

Two sets of inequalities, one based on unitarity and the other on duality, are derived. From them one obtains useful constraints on various Regge couplings involving the Pomeron. The constraints are particularly powerful if the Pomeron is a pole with unit intercept. Interesting relations among the intercepts of the leading Reggeons of different quantum number are also obtained; all agree with the experimental observation. (auth)

28481 BACKWARD $pp \rightarrow d\pi^+$ PROCESS IN A MODEL OF N AND N* EXCHANGE. Sharma, J. S.; Mitra, A. N. (Univ. of Delhi). Phys. Lett., 46B: No. 1, 44-48(3 Sep 1973).

The process $pp \rightarrow d\pi^+$ near backward angles is studied in terms of N and N* exchanges in a model of $N^*N\pi$ couplings developed

previously. Both the angular and energy distributions of the differential cross sections are well reproduced by the model (in marked contrast to the results of contemporary approaches), except for a small fluctuation around 2 GeV in the energy distribution in the backward direction. (auth)

28482 INCREASING p–p AND p–NUCLEUS CROSS SECTIONS. Maor, U.; Nussinov, S. (Tel Aviv Univ., Israel). Phys. Lett.; 46B: No. 1, 99-101(3 Sep 1973).

The p-nucleus cross sections are calculated assuming that total p–p cross sections increase with energy. The dependence on the nucleon structure in b-space is examined and it is found that p–nucleus cross sections grow very rapidly with A if the increasing p–p cross section is attributed to an expanding nucleon halo. (auth)

28483 ISR SINGLE-PARTICLE DISTRIBUTIONS AT X = 0 AND THE DUAL B_6-MODEL WITH POMERON BACKGROUND MODIFICATIONS. Bebel, D.; Biebl, K. J.; Paul, H. (Humboldt Univ., Berlin). Lett. Nuovo Cim.; 8: No. 2, 85-89(8 Sep 1973).

It is pointed out that the results for the approximate linearity in the transverse momentum of the logarithm of the invariant Feynman function for the region $0.14 < p_\perp < 1.3$ GeV for the x = 0 single-particle distribution for the reactions p + p → c + anything, where c = π^+, π^-, K^+, p, $\bar{p}$, are compatible with the predictions of the dual B_6 model if appropriate pomeron background modifications are taken into account. (JFP)

28484 SCALING BOUNDS ON HIGH TRANSVERSE MOMENTA. Rozenblit, M. (Tel Aviv Univ., Israel). Lett. Nuovo Cim.; 8: No. 2, 132-136(8 Sep 1973).

A simple parton model is described and used to explore the implications of causality for a pp collision in the center of mass. It is emphasized that the results for new energy-dependent cut-offs and scaling of s times the cross section are independent of the details of the model. The relevancy of causality is pointed out, and it is shown how it leads to limits which scale on transverse-momenta distributions. (JFP)

28485 SLOPE PARAMETER OF DIFFRACTION PEAK AND THE GROWTH OF σ_t IN p–p SCATTERING. Minami, S.; Terada, M. (Osaka City Univ.). Lett. Nuovo Cim.; 8: No. 2, 113-116 (8 Sep 1973).

The effect of $\Delta\sigma$ on the properties of the slope parameter for p + p and $\bar{p}$ + p scattering is examined. The total cross sections and slope parameter for elastic scattering are found. (JFP)

28486 INCREASE OF SINGLE-PARTICLE SPECTRA AND A NEW FORM OF SCALING. Inclusive Reactions and Urbaryon Rearrangement Diagrams. 5. Kinoshita, K.; Noda, H. (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 49: No. 3, 896-913 (Mar 1973).

The properties of a formula for single-particle distribution function are investigated in connection with the mechanism of the increase of some spectra with energy. A new form of scaling, which approaches Feynman scaling at asymptotic energies, is proposed. Recent experiments on p + p → ($\bar{p}$, K^-, and π^-) + anything up to ISR energies are consistent with the new scaling, in which the energy dependence and the longitudinal shape of the spectrum are simultaneously determined by single parameter for each species of the produced particle. The concave rise of the averaged multiplicity up to ISR energies is obtained as a result of the new scaling: above ISR energies, the logarithmic increase is predicted to set in. The transverse shapes of spectra are shown to reveal their common dependence on longitudinal mass, after factorizing out an energy dependent part on the basis of the new scaling. (auth)

28487 INVARIANT DESCRIPTION OF PERIPHERAL THREE-PARTICLE FINAL STATES. Byckling, E.; Raitio, R.; Tuominiemi, J. (Univ. of Helsinki). Phys. Scr.; 7: No. 4, 165-168(1973).

A way is proposed to describe three body final state reactions by one essential invariant variable. As an example the application of the method to the reaction pp → pπ^+n is discussed. (auth)

28488 MODELS OF THE THREE-BODY SCATTERING PROBLEM. Sharma, V. K. (D. S. Coll., Aligarh, India); Kaushal, R. S. pp 101-104 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28489 SLOPE PARAMETER FOR pp ELASTIC SCATTERING IN THE REGION OF THE COULOMB INTERFERENCE. Chernev, Kh. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 2, 403-405(Aug 1973). (In Russian).

Basing on analysis of the recent experiments the s and t dependence of the slope parameter of the pp elastic scattering differential cross section at the energies more than 10 GeV is considered. The conclusion is that the slope parameter is different for the regions up and down 0.013 $(GeV/c)^2$. (auth)

28490 PION ABSORPTION AND THE PION–DEUTERON SCATTERING LENGTH. Thomas, A. W.; Afnan, I. R. (Flinders Univ. of South Australia, Bedford Park). Phys. Lett., 45B: No. 5, 437-440(20 Aug 1973).

The solution of the Faddeev equations for the πNN system was used as a model for studying pion absorption and elastic scattering on the deuteron. Results indicate that absorption is sensitive to the short range behavior of the deuteron wave function. The contribution of absorption to the πd scattering length is found to be small. (auth)

28491 QUARTET S PHASE SHIFT FOR THE ND SCATTERING BELOW THE THRESHOLD IN THE LINEAR APPROXIMATION IN THE INTERACTION RANGE. Efimov, V. N.; Tkachenko, E. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 62-66(Jul 1973). (In Russian).

Approximation linear in the interaction range and independent on the potential shape is used to calculate the quartet s phase shift of the nd scattering below the deuteron break-up threshold. The calculated results are in good agreement with the experimental data. For the quartet nd scattering length a value of 6.06 f is obtained that is near the experimental value, 6.35 f. (auth)

28492 SINGLE HYPERON PRODUCTION IN pN COLLISIONS AT LOW ENERGIES. Kopeliovich, V. B. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 1, 174-178(Jul 1973). (In Russian).

Contribution from the one-pion exchange to the cross section of the single hyperon production in reactions pN → YN is expressed via the Y → Nπ decay width and the parameter γ, characterizing the ratio of the S and P waves in the decay amplitude. It is shown that the pion pole is distinguished in the S-wave contribution from the Y → Nπ amplitude. At the energies T = 0.6 – 1.0 GeV the contribution from the one-pion exchange to the total cross section of the reaction pN → YN is maximal and is almost by an order of magnitude more than that predicted by the current–current scheme, assuming that the form factor of the ($\bar{Y}$N) ($\bar{N}$N) amplitude as function of the momentum transfer t is the electromagnetic nucleon form factor squared, $[1 + (|t|/0.71)]^{-2}$. (auth)

28493 DETERMINATION OF THE DEUTERON FORM FACTOR FROM THE EXPERIMENTAL DATA ON ELASTIC pd, pp, AND np SMALL ANGLE SCATTERING IN THE ENERGY RANGE 10 TO 26 GeV. Zolin, L. S.; Nikitin, V. A.; Truong Bien; Shafranova, M. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 56-61(Jul 1973). (In Russian).

On basis of the Glauber theory the structure (nuclear) deuteron form factor is determined from the experimental data on the differential cross sections of elastic proton–deuteron, proton–proton and neutron–proton scattering in the energy range 10 to 26 GeV. Among the wave functions considered, the Bressel and Kerman wave function is in the best agreement with the experiment. The obtained data are in agreement with the results of the ed scattering. (auth)

28494 EQUATIONS FOR THREE-PARTICLE RESONANCE WAVE FUNCTION. Simonov, Yu. A.; Badalyan, A. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 73-78(Jul 1973). (In Russian).

For a three-body system the variational expression for the Gilbert–Schmidt eigen–values is obtained that generalizes that for two-particle resonances. Using the explicit form of the asymptotics for the three-particle resonance wave function at E > 0, one gets a system of coupled one-dimensional differential equations for the components of the resonance wave function in various channels. (auth)

Particle invariance Principles and Symmetries

General

28495 (IFVE-STF-72-52) MODULAR LIE ALGEBRA CONTRACTIONS. Khrushchev, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 7p. (In Russian). INIS.

The IW, S, and p contractions of the Lie algebra were examined. The λ contractions, contractions with respect to the dimensions of the algebra, and Γ contractions of the Lie algebra were determined.

λ contractions include as special cases the IW, S, and p contractions. The relation between λ and γ contractions was examined and examples of λ and γ contractions of some Lie algebra were discussed. (tr-auth)

28496 COMMENT ON THE REALITY CLASSIFICATION OF SPACE GROUP REPRESENTATIONS. Backhouse, N. B. (Univ. of Liverpool). J. Phys., A (London); 6: No. 8, 1115-1118(Aug 1973).

A connection between the reality type of a group representation, and the symmetrized and antisymmetrized squares of that representation is noted. The correspondence leads to a simple reality test for space group representations. A detailed analysis reproduces the Herring test. (auth)

28497 NOTE ON THE REPRESENTATION OF SU(n) AND SU(n,1) CONNECTED WITH THE HARMONIC OSCILLATOR. King, G. M. (Univ. of Lancaster, Eng.). J. Phys., A (London); 6: No. 8, 1110-1114(Aug 1973).

One of the well known relations between SU(n) and the n dimensional isotropic harmonic oscillator is examined and extended to show exactly which representations of SU(n) can occur on the degeneracy spaces. The method is further extended to show which representations of SU(n,1) can be generated by the oscillator problem. (auth)

28498 COMPLEX ANGULAR MOMENTA AND THE LORENTZ GROUP. Basu, D.; Majumdar, S. D. (Indian Inst. of Tech., Kharagpur). J. Phys., A (London); 6: No. 8, 1097-1109(Aug 1973).

The unitary irreducible representations of the group SL(2C) are studied by taking the coupled states of two angular momenta J_1 and J_2 as basis functions. The unitarity of the representations leads to unphysical values of j_1 and j_2 such that one of the quantities $\sigma = j_1 + j_2 + 1$ and $j_{12} = j_1 - j_2$ is integral or half-integral and the other is purely imaginary or real. The formulas derived exhibit a beautiful symmetry with respect to the interchange of these two quantities. The basis functions are expressible in terms of terminating hypergeometric series, and, by using the properties of the latter, the matrices of the generators and of finite transformations are easily determined. The matrix element of the "boost operator" corresponding to a pure Lorentz transformation in the x_3-x_4 plane is found to take the form of a finite linear combination of ${}_3F_2$ functions. (auth)

28499 PROJECTIVE REPRESENTATIONS OF SL(3,C) IN THE Z OPERATOR FORMALISM. Bars, I. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 14: No. 6, 759-769(Jun 1973).

An operator formalism, previously developed to discuss the Gel'fand–Naimark z-basis for the homogeneous Lorentz group, is now generalized to treat the projective representations of SL (3,C). The projective "position" operators Z_1, Z_2, Z_3, as well as their canonical conjugate "momenta" Π_1, Π_2, Π_3 which form the building blocks of the generators of SL(3,C) are found. The z-representation, the states in which the "position" operators Z_i are diagonal, has very simple global transformation properties. This representation also leads to a Hilbert space endowed with an affine metric G, which relates the "covariant" and "contravariant" states. All unitary representations are unified by means of a single scalar product in which the matrix elements of G play the role of an intertwining operator. (auth)

28500 HOW IS CHIRAL $SU_3 \otimes SU_3$ SYMMETRY BROKEN? Yang, T. C. (Univ. of California, San Diego, La Jolla). Nuovo Cim.; 17A: No. 2, 311-328(21 Sep 1973).

The exact $SU_2 \otimes SU_2$ symmetry limit and the SU_3 symmetry limit are considered separately in the hope that one of them may be a good symmetry group of Nature. Application of the Bjorken limit for the three-point function and conservation of current lead to the commutation relation for the charge and the σ-term. Spectral-function sum rules are obtained, and compared with available experimental data. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 28316 and 28935.

28501 (FRNC-TH-390) MEASUREMENT OF THE η_+ CP VIOLATION PARAMETER IN THE DECAY OF K^0 INTO TWO CHARGED PIONS. Vannucci, F. (Paris Univ., Orsay (France)). 1973. 112p. (In French). Dep. NTIS (U.S. Sales Only) $7.75.

Thesis.

The decay of K^0 into two charged pions was studied by attempting to achieve a high experimental accuracy in view of comparing the limited experimental results with various theories concerning the violation of CP. In order to accomplish this, particular attention was given to minimizing the problems connected with background noise (utilization of detection equipment presenting only a very small quantity of matter to the beam ($0.3 g/cm^2$) and to obtaining large amounts of data (a total of 2 million $K\pi_3$ decays were used in the analysis). The preliminary results arise from a partial analysis based on about half of the data: $\eta_+ = (2.33 \pm 0.05)10^{-3}$, and $\phi_+ = 45 \text{ deg} \pm 2 \text{ deg} + (\Delta m - 0.532)/0.532 \times 300 \text{ deg}$. (auth)

28502 TIME DECAY DISTRIBUTIONS OF $\bar{K}^0$ AND K^0 TO $\pi^+\pi^-$: A CP TEST. Frank, J. S. Urbana, IL; Univ. of Illinois (1972). 102p. University Microfilms Order No. 73-17,208.

Thesis (Ph.D.).

A direct comparison of the time decay distributions of $\bar{K}^0$ and K^0 to $\pi^+\pi^-$ was made at the Argonne National Laboratory Zero Gradient Synchrotron. The neutral kaons were produced by charge exchange of 850 MeV/c charged kaons on a carbon target. Their subsequent decays were tracked with magnetostrictive wire spark chambers in the range from 4 to 12 K_S lifetimes. No magnetic analysis was required in order to analyze the kinematics of each event. A 3.5 standard deviation effect for direct evidence of CP violation is found. This is independent of any theoretical decay formalism. Good agreement is also found with the usual formalism of CP violation in the $\pi^+\pi^-$ decay mode of the neutral kaon system. This is the first time that CP violation has been observed in $\bar{K}^0$ decay. (auth)

28503 COMPARISON OF CP VIOLATION IN THE DECAYS $K^0 \to \pi^+\pi^-$ AND $\bar{K}^0 \to \pi^+\pi^-$. Raither, S. W. Urbana, IL; Univ. of Illinois (1972). 103p. University Microfilms Order No. 73-17,376.

Thesis (Ph.D.).

The time dependence of the decay rates $K^0 \to \pi^+\pi^-$ and $\bar{K}^0 \to \pi^+\pi^-$ was measured in order to test the validity of current formulations of CP violations. An enriched kaon beam at Argonne National Laboratory was used to produce K^0 ($\bar{K}^0$) by charge exchange of 850 MeV/c K^+ (K^-) on complex nuclei. Magnetostrictive wire spark chambers and scintillation counters were used to measure the $\pi^+\pi^-$ rates in the interval from four to twelve K_S^0 lifetimes. The time distributions of these decay rates agree with those expected from prevalent theories of CP violation. (auth)

28504 GAUGE-INVARIANT MODEL OF THE ELECTROMAGNETIC AND WEAK LEPTON INTERACTION. Faddeev, L. D. (Mathematics Inst., Leningrad). Dokl. Akad. Nauk SSSR; 210: No. 4, 807-810(1 Jun 1973). (In Russian).

It is proposed that the electromagnetic and weak interactions (EM + W) be combined by means of a multiplet of gauge fields. This gauge invariant model is based on the simplest, nontrivial gauge group O(3), and contains thus only a triplet of vector fields. (SJR)

28505 SYMMETRY-BREAKING MODELS FOR $\eta'\eta$ SIGMA-TERM. Harun Ar Rashid, A. M. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 17A: No. 2, 288-302(21 Sep 1973).

In the framework of the effective Lagrangians which include both dilatational symmetry breaking as well as chiral symmetry breaking of $(3,\bar{3}) \oplus (\bar{3},3)$ and (8,8) types, the $\eta'\eta$ matrix element of the sigma-commutator is evaluated. The current algebra relation between the sigma-term and the $\eta\pi \to \eta'\pi$ scattering amplitude is first derived from the effective Lagrangian in both the $(3,\bar{3}) \oplus (\bar{3},3)$ and (8,8) models. The expressions for the sigma-term obtained in the former model agree with those derived by other authors from current algebra, but the underlying assumptions in the current algebra calculations are here clarified. It is pointed out that a combination of $(3,\bar{3}) \oplus (\bar{3},3)$ and (8,8) types of symmetry breaking previously suggested can explain the $\eta' \to \eta\pi\pi$ decay rate reasonably well. (auth)

28506 MASS FORMULA IN SU(3) SYMMETRY WITH ELLIPTICAL BASIS. Lukach, I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 202-209(Jul 1973). (In Russian).

The mass formula in SU(3) symmetry with elliptical basis involving the mass splitting of supermultiplets by simultaneous strong and electromagnetic interactions is obtained. The mass spectrum of baryon octet, decuplet and 27-plet is considered. New sum rules are found for the masses of particles in octet. (auth)

Applications (Strong)

28507 (DESY-73/26) CHIRAL INVARIANCE AND LOW-ENERGY PION–PION SCATTERING. Lehmann, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jun 1973. 25p. Dep. NTIS (U.S. Sales Only) $3.25.

Recent work on the consequences of chiral invariance for $\pi\pi$ scattering is described. A formulation of chiral invariance is given in the context of general quantum field theory, and from it the Adler–Weinberg theory for $\pi\pi$ scattering is derived. An

extension of this theorem to higher pion momenta and its application to the scattering phase shifts in an effective range approximation is then discussed. Finally, attempts to obtain further information on $\pi\pi$ scattering by making dynamical assumptions beyond chiral invariance and treating a Lagrangian field-theoretic model for the interaction of pions and nucleons in the one-loop approximation are discussed. (LBS)

28508 TRIALITY EXOTICS, AND THE DYNAMICAL BASIS OF THE QUARK MODEL. Lipkin, H. J. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 45B: No. 3, 267-271 (23 Jul 1973).

A nonrelativistic three-triplet model with a simple two-body interaction is shown to bind only $q\bar{q}$ and qqq states. Three triplets and unobserved charmed states are crucial in preventing binding of 4 $q\bar{q}$ and 2 $q\bar{q}$ systems. They provide repulsive channels to make the $q\bar{q}$ and 3q systems behave like "neutral atoms" with canceling attractive and repulsive forces between them and additional quarks. The ratio of $q\bar{q}$ and $q\bar{q}$ interactions is just right to bind the $q\bar{q}$ and 3q systems properly while leaving the $q\bar{q}$ system with the mass of a quark. (auth)

28509 $^3P_0$ MODEL FOR BARYON DECAY MATRIX ELEMENTS AND $SU(6)_W$. Petersen, W. P. Minneapolis; Univ. of Minnesota (1973). 84p. University Microfilms Order No. 73-18,142. Thesis (Ph.D.).

Making modest use of the quark model it is found that many features of the two body decays of baryon resonances can be described fairly well. A specific prescription for the SU(6) ⊗ O(3) couplings of baryon resonances to "stable" final states originally proposed by Micu is used to relate $\frac{1}{2}^+0^-$, $\frac{3}{2}^+0^-$, $\frac{1}{2}^+1^-$, and $\frac{1}{2}^+\gamma$ final state interactions. This $^3P_0$ model in which a 0^+ $q\bar{q}$ pair inserted in the trilinear coupling is shown to be equivalent to an "1-broken" $SU(6)_W$ covariant decay symmetry for these cases. It is found that the $SU(6)_W$ implied relation between two partial waves contributing to two body decays should be broken. Using experimentally well-established partial widths into $\frac{1}{2}^+0^-$ and $\frac{3}{2}^+0^-$ final states the S and D wave parameters are fitted in 70, $L = 1^-$ and P and F wave parameters are fitted in 56, $L = 2^+$ SU(6) ⊗ O(3) multiplets. The "hard core" S-wave amplitudes are seen to give trouble, at least at higher resonant masses. More peripheral P, D, F excitations seem to be adequately well described however. Vector meson decays are discussed, with the model predicting some dominant amplitudes and features correctly. Then using the SU(6) charge operator, extensions to describe photoproduction are made and several features of resonant photoproduction are considered. In fact, a test from photoproduction is used to determine the validity of the $SU(6)_W$ implied relationship between S and D, P and F. It is found that these pairs of amplitudes differ in sign from the $SU(6)_W$ prediction, a violation of $SU(6)_W$ not explicable on the basis of centrifugal barriers. (auth)

28510 SU(2) CHIRAL BREAKING AND ETA → 3π DECAY. Cicogna, G. (Univ., Pisa, Italy); Strocchi, F.; Vergara Caffarelli, R. Phys. Lett.; 46B: No. 2, 217-220(17 Sep 1973).

A model independent calculation of the $\eta \to 3\pi$ decay rate is performed in the framework of SU(2) chiral breaking ($\epsilon_3 u_3$). The problem of accounting for the experimental value is resolved with a value of ϵ_3 in agreement with the baryon and meson e.m. mass differences. (auth)

28511 SU(3) NONINVARIANT VACUUM AND THE CABIBBO ANGLE. Lanik, J. (Slovenska Akademia Vied, Bratislava). Phys. Lett.; 46B: No. 2, 198-200(17 Sep 1973).

A connection between chiral symmetry breaking and the Cabibbo angle is formulated in a new way within the framework of the $(3, \bar{3}) \oplus (\bar{3}, 3)$ model. The essential feature of this formulation is the assumption about the SU(3) noninvariance of the vacuum. In such a way it is shown that no isopin symmetry breaking of the hadron world is needed to explain the magnitude of the Cabibbo angle. (auth)

28512 SU_{6w}-BREAKING PATTERN IMPLIED BY THE TRANSFORMATION FROM CONSTITUENT TO CURRENT QUARKS. Buccella, F. (Univ., Rome); Nicolo, F.; Pugliese, A. Lett. Nuovo Cim.; 8: No. 4, 244-248(22 Sep 1973).

A proposal was previously made for a physical interpretation of the operator which connects the axial charges to the SU(6) generators in the framework of the idea of constituent and current quarks. Arguments are presented that show that the W-spin symmetry breaking appears when one looks for a unitary operator acting on the physical systems made up by three quarks or by a quark–antiquark pair, generalizing the single-quark case; on the other hand to pass from the single-quark case to the physical one implies the presence of an interaction between the constituent quarks, in general not $SU(6)_w$ invariant, and therefore to this interaction has to be ascribed the pattern of representations chosen by nature for the physical particles. The construction of a unitary operator acting on the physical states classified in the SU(6) × O(3) representations is suggested. (LBS)

28513 CAN THE $J^{PC} = 1^{++}$ MESONS FORM AN IDEAL NONET. Laankan, T.; Oneda, S. (Univ. of Maryland, College Park). Phys. Lett.; 46B: No. 1, 77-80(3 Sep 1973).

In the framework of asymptotic SU(3) and the chiral SU(3) ⊗ SU(3) charge albegra, it is argued that the 1^{2+} mesons can form an (almost) ideal nonet along with the 1^{2-} mesons. Experimental implications are also discussed. (auth)

28514 BROKEN CONFORMAL SYMMETRY AND HADRONIC SCALING. Domokos, G.; Koevesi-Domokos, S.; Yunn, B. C. (Johns Hopkins Univ., Baltimore). Phys. Lett.; 46B: No. 1, 83-87(3 Sep 1973).

High energy, large momentum transfer hadronic reactions are studied in the framework of broken conformal symmetry. Hadrons lie on almost linear Regge trajectories. Inclusive cross section scale as $\sim s^{-2}(q_T^2/s)^{-4}$. Large rates of heavy particle production are predicted. (auth)

28515 SCALAR AND PSEUDOSCALAR MESONS IN BROKEN NONLINEAR CHIRAL SU(3) ⊗ SU(3) DYNAMICS. Il'in, Yu. M.; Sabo, V. Ya. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 18: No. 2, 464-469(Aug 1973). (In Russian).

Broken nonlinear chiral SU(3) ⊗ SU(3) dynamics of scalar and pseudoscalar mesons is constructed. The symmetry breaking is introduced in a "linear-covariant" way. The obtained consequences are compared with experimental data, as well as with results of a model, where the Gell-Mann–Oakes–Renner symmetry breaking was used. (auth)

Scattering Theory

Refer also to abstracts 28952 and 29145.

28516 (IAE-2187) POTENTIAL HARMONICS IN THE THREE-BODY PROBLEM. Pustovalov, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1972. 8p. (In Russian). INIS.

Potential harmonics assure the most rapid convergence in the method of K-harmonics. A "tree" style function for three particles, corresponding to potential harmonics, was resolved along the angular functions $W^{\nu}_{KLM}(\Omega)$ with quantum numbers K, L = 2, M, ν. Potential harmonics were obtained after symmetrization; allowing for permutation properties of the functions $W^{\nu}(\Omega)$ became elementary operations. The method of calculating matrix elements from a realistic potential from the functions $W^{\nu}(\Omega)$ is elucidated. (tr-auth)

28517 (IFA-FT-97-1972) ITERATIVE SOLUTION FOR RELATIVISTIC SCATTERING. Stihi, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 22p. NTIS.

A convergent iterative procedure for solving the relativistic partial wave scattering problem based on Laplace transforms is developed. Approximate solutions in closed analytic form can be obtained. They are closer to the exact solution, as the higher the energy is. (auth)

28518 FACTORIZING DUAL AMPLITUDE WITH MANDELSTAM ANALYTICITY. Gonzalez Mestres, L.; Hong Tuan, R. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 45B: No. 3, 282-286(23 Jul 1973).

A N-point function is presented with following properties: it factorizes, it has Regge asymptotic behavior with nonlinear trajectories, it has Mandelstam analyticity, it reduces to the Veneziano N-point function in the narrow resonance limit. (auth)

28519 GREEN FUNCTIONS AND PROJECTION OPERATORS IN THE SEMICLASSICAL APPROXIMATION. Hahn, Y. (New York Univ., NY); Watson, K. M. Phys. Lett., B; 45B: No. 4, 304-308(6 Aug 1973).

Closed forms of the Green functions and projection operators for quantum mechanical systems of two and three interacting particles are derived in the semi-classical approximation based on the Wigner transformation. An application to high energy potential scattering yields very accurate amplitudes at large angles. (auth)

28520 MULTIPARTICLE SHADOW EFFECTS ON ELASTIC SCATTERING IN THE DUAL MODEL. Hong-Mo, C. (Rutherford High Energy Lab., Berkshire, Eng.); Paton, J. E. Phys. Lett.; 46B: No. 2, 228-232(17 Sep 1973).

Unitarity effects of multiparticle channels on elastic scattering are studied schematically in the dual model. Explanations are offered for (A) the difference in energy dependence between "Pomeron" and isospin exchanges, (B) the difference in the slopes of diffraction peaks for exotic and non exotic reactions, and (C) the "cross-over" phenomenon.

28521 FIELD THEORY DESCRIBING ARBITRARY TWO-BODY SCATTERING AMPLITUDE AS A BORN TERM. Lukierski, J. (Univ., Wroclaw). Fortschr. Phys.; 21: No. 2, 85-112(1973).

The local relativistic quantum field-theoretic formulation of the most general isobar model, with unstable two-particle isobars having arbitrary mass and spin spectrum, is proposed. Such infinite family of isobars is described by infinite-component field operator with its components given by symmetric, traceless and divergenceless field operators $\varphi_{u_1 \ldots u_I}(x;s)$, where I describes spin (I = 0, 1, 2...) and the continuous parameter S the spectrum of asymptotic masses. The asymptotic free states defined by generalized LSZ limits of $\varphi_{u_1 \ldots u_I}(x;s)$ can be described by means of stable multiparticle states. In such a field theory one can choose the parameters in such a way that already a Born term describes an arbitrarily chosen two-body scattering amplitude. As an example the generalization of Van Hove model of Reggeons to the case of complex Regge trajectory, describing Regge family of resonances on the second sheet is presented. Finally the correspondence with conventional theory is discussed. It is shown that the Feynman diagrams in local field-theoretic isobar model can be interpreted in the framework of nonlocal theory describing in some approximation an equivalent interaction between stable decay products. (auth)

28522 NUMERICAL AIDE IN THE LOCATION OF FEW-BODY BOUND STATES. Lavine, J. P. (Univ., Leige). J. Comput. Phys.; 12: No. 4, 561-566(Aug 1973).

The application of linear fractions, that is, the Pade approximant of type II to the determination of two- and three-body bound states is discussed. (JFP)

28523 RELATIVISTIC INFINITE COMPONENT WAVE EQUATION WITH THE INTERNAL STRUCTURE OF A THREE-DIMENSIONAL HARMONIC OSCILLATOR. Portner, G. J. New York; City Coll. (1973). 81p. University Microfilms Order No. 73-18,537.

Thesis (Ph.D.).

A representation of the group SU(3,1) which contains a Lorentz four-vector is used as the basis of an infinite component wave equation. The wave equation has a linearly increasing harmonic oscillator $(\text{mass})^2$ spectrum, the rest frame wave functions being those of a nonrelativistic three-dimensional harmonic oscillator. Spacelike solutions of the wave equation are expressible as a linear combination of four time-like solutions so that the Hilbert space of timelike solutions is complete. Properties of the wave equation, its solutions and the associated currents are discussed. A lowest order, ghost free, scattering amplitude is obtained, and some of its analytic properties are discussed. A possible extension of the model to half integral spin is described. (Diss. Abstr.)

28524 THRESHOLD BEHAVIOR OF THE THREE-PARTICLE SCATTERING AMPLITUDE AND GAS APPROXIMATION IN THE MANY-BODY PROBLEM. Simenog, I. V. (Inst. for Theoretical Physics, Kiev). Phys. Lett.; 46B: No. 1, 31-33(3 Sep 1973).

It is established by investigation of the gas approximation for the ground state energy in many-body problem how the low energy parameters of the two-particle and essentially three-particle amplitude determine the dominant terms of the energy expansion in series of gas parameter. The correspondence to the gas approximation in the Faddeev integral equations in the form of the three-particle amplitude low energy behavior near the threshold $E \to 0$ is obtained. (auth)

28525 FINITE-CONTOUR DISPERSIVE INEQUALITIES. Celik, T. (Univ. of Rochester, NY); Palmer, D. R. J. Math. Phys. (N. Y.); 14: No. 6, 770-773(Jun 1973).

Finite-contour dispersive inequalities are derived for a function $f(\xi)$ which is analytic in the ξ plane except for a right-hand cut. Inequalities are also derived for the derivative of the function. These inequalities are rigorous and the sharpest ones that can be derived using only analyticity. (auth)

28526 SCATTERING INTO CONES. II. n-body Problems. Dollard, J. D. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.); 14: No. 6, 708-718(Jun 1973).

An n-body scattering process is studied in the framework of nonrelativistic time-dependent scattering theory. The probability is calculated that the n bodies emerge in cones $C_1, \ldots, C_n$ with apices at the origin of coordinates. Results are given for short-range and for Coulomb potentials. The results corroborate the usual interpretation of time-dependent scattering theory. (auth)

28527 ASYMPTOTICS OF AN AMPLITUDE AS RESULT OF SUMMING UP RESONANCES IN CROSSED CHANNEL. Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 18: No. 2, 425-430(Aug 1973). (In Russian).

High energy amplitude is constructed summing up resonances in the t channel. Account of the resonance widths results in a fixed cut and pairs of complex-conjugated poles in the J plane. Properties of the model are discussed. (auth)

28528 ONE-CURRENT AMPLITUDES IN THE MODEL OF NEVEU AND SCHWARZ. Montonen, C. (Univ. of Cambridge, Eng.). Nuovo Cim.; 17A: No. 2, 366-374(21 Sep 1973).

Operators representing even G-parity scalar and conserved vector currents and an odd G-parity axial vector current are constructed and the corresponding one-current amplitudes evaluated in the Neveu–Schwarz dual-resonance model by means of a scheme proposed by Neveu, Scherk and Cremmer. The amplitudes satisfy planar duality and the axial vector current realizes a dual version of PCAC. (auth)

28529 PHASE-SHIFT AMBIGUITIES FOR ANALYTIC AMPLITUDES. Itzykson, C.; Martin, A. (CERN, Geneva). Nuovo Cim.; 17A: No. 2, 245-287(21 Sep 1973).

An investigation is made of ambiguities in reconstructing a unitary elastic amplitude at fixed energy given the differential cross section when one assumes analyticity in the $\cos\theta$ plane. Strong hints are given that not more than a twofold nontrivial ambiguity is present. This is demonstrated for genuine entire functions of finite order. Moreover it is found that within a class of amplitudes which includes polynomials as well as entire functions of order zero, i) the difference between the two amplitudes with the same cross section must be a polynomial, ii) if the cross section is smaller than 1.38 $(4\pi/k^2)$ there is no ambiguity. Indications are given on directions for future work. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

28530 STRUCTURE AND EXCITATIONS OF LIQUID HELIUM. Woods, A. D. B.; Cowley, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Rep. Progr. Phys.; 36: No. 9, 1135-1231 (1973).

During the past decade there has been considerable progress in the study of the structure and elementary excitations of liquid helium. This has largely arisen from the development and refinement of neutron, x ray and light scattering techniques and also from more detailed ultrasonic measurements. A large part of this review is concerned with describing the results of these experiments and their implications for theories of liquid helium. During the last few years there has also been considerable progress made in the theory of the excitations in liquid helium. These developments are briefly reviewed and the most promising lines of development indicated. (auth)

28531 FIRST VISCOSITY OF SUPERFLUID HELIUM 3 AT LOW TEMPERATURES. Seiden, J. (CNRS, Orsay, France). Compt. Rend., Ser. A, B; 276: No. 25, 905-913(18 Jun 1973). (In French).

It was shown that in the BW (Balian–Werthaner) phase of helium 3, i.e. at temperatures lower than T_B = 2,2mK, the coefficient of first viscosity eta is independent of the temperature. (FR)

28532 DIFFUSION AND THERMODIFFUSION IN DILUTED MIXTURES OF ^{3}He IN LIQUID ^{3}He AT VERY LOW TEMPERATURE. Dandache, H.; Laheurte, J. P.; Papoular, M. (CNRS, Grenoble, France). J. Phys. (Paris); 34: No. 7, 643-649(Jul 1973). (In French).

A theory for mass diffusion (D) and thermodiffusion (K_T) in liquid helium isotopic mixtures at low ^{4}He concentration (C) is presented. At high temperature ($T \sim 1K$), K_T is phenomenologically related to the variation of the thermal conductivity as compared to pure ^{3}He. At very low temperature a calculation based on the Boltzmann equation gives $D \sim T^{-1}$ and $K_T = +2c$. (FR)

28533 THERMODIFFUSION AND CORRECTION IN DILUTED MIXTURES OF ^{4}He IN LIQUID ^{3}He. Dandache, H.; Laheurte, J. P. (CNRS, Grenoble, France). J. Phys. (Paris); 34: No. 7, 635-642(Jul 1973). (In French).

Measurements of concentration gradients due to heat flow in two dilute liquid mixtures of ^{4}He in ^{3}He are presented. Changes in concentrations were observed by measuring the dielectric constant, the volumes occupied by the two isotopes being different. It was shown that in usual experiments the effects of heat flow may be important and disturb the measurements. In the instability range the effective thermal diffusion ratio was measured. Its negative value means that the heavier isotope (^{4}He) is transferred toward the hot end of the liquid. Further experimentation of the thermal diffusion radio should be undertaken in helium mixtures. (FR)

28534 DYNAMICS OF CHARGED VORTEX RINGS IN SUPERFLUID HELIUM. Yu, M. Y. (Univ. of Umeaa, Sweden). Phys. Scr.; 8: No. 1-2, 67-69(1973).

A microscopic theory for the interaction of charged, quantized, vortex rings in superfluid helium is suggested. The conclusions derived from this theory agree with existing macroscopic theories and experiments. The dynamics of individual vortex rings as well as effects of collisions are also discussed. (auth)

28535 SUPERFLUIDITY IN LIQUID ^{3}He. Condensation in the L = 2 or L = 3 State. Oestgaard, E. Ark. Fys. Seminar Trondheim; No. 14, 1-15(1973).

The possibility of superfluidity in liquid ^{3}He is investigated, and the corresponding critical temperature is calculated or estimated. In the calculations are used reaction-matrix elements calculated earlier by means of Brueckner theory. The results indicate that there is no superfluidity corresponding to S-state or P-state pairing in liquid ^{3}He. There is, however, probably superfluidity corresponding to D-state or F-state pairing. The largest transition temperature is obtained for L = 3, i.e., anisotropic superfluidity corresponding to the triplet F-state seems to be more likely than the singlet D-state pairing predicted earlier. Estimated critical temperatures for L = 3 are approximately 2.6 mK to 17.6 mK, while experimental results now indicate a value of 2.6 mK. For l = 2 we obtain critical temperatures of approximately 0.4 to 2.2 mK. Similar methods have also earlier predicted a too high critical temperature for liquid ^{3}He. (auth)

28536 LOW TEMPERATURE SUPERFLOW OF HELIUM II IN RESTRICTED GEOMETRIES. Schwenterly, S. W. III. Ithaca, NY; Cornell Univ. (1973). 106p. University Microfilms Order No. 73-22,529.

Thesis (Ph. D.).

The flow of He II through fine pores in tightly packed lampblack has been investigated at temperatures ranging from 70mK to 1.7K. The pore diameter is estimated to be approximately 20 Å. The apparatus was a U-tube consisting of two vertical standpipes connected by a cross channel containing the porous sample. The frequency of liquid level oscillations was observed by means of capacitors in the standpipes. Because the normal component of the fluid is held stationary in fine pores, changes in the superfluid fraction in the pores alter the effective area available for fluid flow, producing a proportionate change in the square of the oscillation frequency. Hence the temperature dependence of the average superfluid fraction in the pores may be inferred. The results indicate that the superfluid fraction drops by several percent as T rises from 70mK to 1K, in sharp contrast with the nearly temperature-independent behavior of the bulk fluid. For T < .5K, the average superfluid fraction closely follows the relation $\langle \rho_s \rangle / \rho = K_0(1-\gamma T)$, where K_0 is presumably of order unity, and γ increases as the pore diameter is decreased. This reduction of the average superfluid fraction is discussed in terms of a limitation on the allowed phonon wave vectors imposed by the pore walls. In this context, the linear temperature dependence of the superfluid fraction indicates that porous lampblack is "zero-dimensional" in the sense that it restricts fluid flow in all directions. (Diss. Abstr. Int., B)

28537 REVIEW PAPER: THE HYDRODYNAMICS OF HELIUM II FILM. de Bruyn Ouboter, R. (Kamerlingh Onnes Laboratorium, Leiden). J. Low Temp. Phys.; 12: No. 1-2, 3-23(Jul 1973).

After an introduction to the hydrodynamical properties of He II, a survey is given of the flow properties of superfluid helium in the film. Special attention is given to some unsolved problems, such as: has rotating He II ($\omega < \omega_{c1}$) a shrunken temperature-dependent parabolic meniscus and is a stationary moving He II film thinner than a static film? A review will be given of the present state of affairs both from an experimental and theoretical point of view. (auth)

28538 COMPRESSIONAL COOLING AND ULTRALOW TEMPERATURE PROPERTIES OF ^{3}He. Osheroff, D. D. Ithaca, NY; Cornell Univ. (1973). 156p. University Microfilms Order No. 73-20,171.

Thesis (Ph. D.).

The technique of compressional cooling of He^3 is investigated using a versatile device. Several characteristics of the cooling process are discussed. Thermometry using NMR techniques on copper and platinum metals is described and the two thermometers are compared with each other and with the He^3 melting curve to temperatures as low as 2.7 mK. Finally, the discovery of new phases of liquid He^3 at temperatures below 3 mK is described in detail, including the properties of the new phases as observed through the compression process and NMR techniques. (Diss. Abstr. Int., B)

28539 OBSERVATIONS OF LOW LYING SUPERFLUID STATES IN A RECTANGULAR ANNULUS. Gregory, D. D. San Diego, CA; Univ. of California (1973). 143p. University Microfilms Order No. 73-21,192.

Thesis (Ph.D.).

A sealed, hollow annulus filled with superfluid helium and set into torsion oscillations about its axis has been used to determine the critical angular velocity at which energy and momentum are transferred to the fluid. It has been used to measure the quantization of the circulation of the superfluid. The feasibility of developing the instrument as a rotation detector has been explored. The present system has enough sensitivity as a rotation detector to see the rotation rate of the earth with a signal to noise ratio of one to one. Three different annular containers were used. Two of the annular containers differed in the size of the inner and outer radii, and two of the containers differed in the texture of the surface of the inner radius. Each of the different annular containers exhibited a different critical angular velocity. A semi-classical hydrodynamic theory is used to make a theoretical estimate of the critical angular velocities of the different annular containers. These theoretical estimates are within an order of magnitude of the experimental values obtained. Present noise sources are discussed and guide lines for a future apparatus are presented. The direction of further experimental work also is indicated. (Diss. Abstr. Int., B)

28540 MEASUREMENTS ON LIQUID ^{3}He BELOW 5 m°K. Stolfa, D. L. San Diego, CA; Univ. of California (1973). 177p. University Microfilms Order No. 73-18,855.

Thesis (Ph.D.).

A refrigerator using the principle of adiabatic nuclear demagnetization of copper is used to cool liquid ^{3}He to less than 2 m°K. The thermal resistance between this refrigerator and the liquid ^{3}He is reduced to an acceptable size by using sintered copper powder to increase the surface area between the ^{3}He and the copper container. A technique of thermometry using nonresonant nuclear magnetic susceptibility of metals is developed. Such a technique holds the promise of lower power dissipation and hence better thermal equilibrium between thermometer and experiment than do other methods of thermometry. The properties of ^{3}He are investigated to identify any anomalies that may be attributed to the newly-found correlated state near 2 m°K in liquid ^{3}He by the Cornell group. The non-resonant static susceptibility of ^{3}He is measured at 0.5 atmospheres with no observable change in susceptibility that can be ascribed to the ^{3}He. The ^{3}He heat capacity is measured at 0.5 and 26.4 atmospheres. The low pressure data gives no indication of abnormal behavior but at high pressure there clearly appears to be a peak excess heat capacity at 2.1 m°K. The excess entropy associated with this anomaly is $\Delta S/nR = 2.6 \times 10^{-3}$. The boundary impedance between the liquid ^{3}He and the sintered copper powder appears to be much smaller than expected. This possibly indicates the existence of a transport mechanism that by-passes the Kapitza and electron–phonon thermal resistances in much the same way as is found at CMN–^{3}He interfaces at low temperatures. (Diss. Abstr. Int., B)

28541 VISCOSITY OF DILUTE ^{3}He–^{4}He MIXTURES AT LOW TEMPERATURES. Kuenhold, K. A. Columbus, OH; Ohio State Univ. (1973). 137p. University Microfilms Order No. 73-18,919.

Thesis (Ph.D.).

The viscosity of dilute solutions of ^{3}He in ^{4}He has been measured at concentrations of 0.001, 0.005, 0.013, 0.027, 0.050, and 0.07 over the temperature range of 0.03°K to 0.9°K. The apparatus consisted of two reservoirs connected by a capillary tube of length 75 cm and diameter 0.028 cm. After the level in one reservoir was lowered, the flow of the mixture through the capillary was monitored with a capacitor semi-immersed in one reservoir. At 1.3% and 5% our results agree with measurements of Fisk and Hall employing a vibrating wire viscometer to about 10 to 15% in the temperature range from 0.1°K to 0.6°K, and are in excellent agreement at lower temperatures. Measurements using the torsional crystal viscometer yield viscosities that are an order of magnitude lower at low temperatures, indicating that this method does not measure hydrodynamic viscosities of dilute solutions at low temperatures. At these same two concentrations our results are in qualitative agreement but about 20% lower than the theoretical calculations of Baym and Ebner. The component of viscosity due to ^{3}He–^{3}He quasiparticle scattering in the classical regime has been deduced from our measurements. It was found that a dipolar scattering amplitude, which depends on the quasiparticle momenta as well as on the momentum transfer, does not fit the deduced ^{3}He–^{3}He viscosity without including a factor that reduces the scattering amplitude at large values of momentum transfer. The results of using this form of the scattering amplitude to calculate viscosity, spin diffusion, and thermal conductivity coefficients for a degenerate Fermi gas were also calculated; comparison has been made with calculations using a scattering amplitude which depends only on the momentum transfer. (Diss. Abstr. Int., B)

28542 THIRD SOUND IN THIN HELIUM FILMS. Ratnam, B. A. Urbana, IL; Univ. of Illinois (1972). 112p. University Microfilms Order No. 73-17,379.

Thesis (Ph. D.).

Experimental investigations into the superflow properties of two-dimensional superfluid helium are reported. The velocity and attenuation of third sound have been measured in a novel way in thin superfluid ^{4}He and ^{3}He–^{4}He films. In the third sound resonance cells a unique thermodynamic state of thin helium films was obtained, which allows precision measurements of the third sound velocity and attenuation. Resonance Qs ≈ (attenuation)$^{-1}$ ≈ 3×10^4 have been achieved in pure ^{4}He films. Third sound resonances indicate a cutoff for the propagation of third sound in thin helium films at finite values of the average superfluid density, $\bar{\rho}_{sf}$, in the film. This cutoff is accompanied by an exponential rise in the dc thermal resistance of the helium film which indicates the formation of high energy excitations of 0.08 eV. Addition of ^{3}He to the ^{4}He film produces several dramatic changes in the propagation of third sound. 1) The third sound propagation transition temperature, the onset temperature, remains unchanged and 2) the third sound velocity is depressed. Increasing ^{3}He decreases the attenuation at high temperatures and increases it at low temperatures. At low temperatures the ^{3}He present dominates the attenuation. At low ^{3}He concentrations ^{3}He surface state effects are seen and at high concentrations a ^{3}He–^{4}He phase separation is observed. (Diss. Abstr. Int., B)

28543 OSCILLATION DAMPING OF THE FREE SURFACE OF A SUPERFLUID LIQUID. Kompaneets, D. A. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 252-260(Jul 1973). (In Russian).

A complete set of equations describing the surface of a superfluid liquid at low temperatures is found by employing the kinetic equation for the distribution function of impurity surface excitations. The oscillation spectrum of the surface is investigated by taking into account damping. It is shown that low-frequency second sound is ordinary sound in a two-dimensional Fermi fluid if the impurities are strongly degenerate; at high frequencies surface second sound goes over to zero-sound. Capillary waves with a wavelength $\lambda \ll l$ (l is the excitation mean free path) experience Landau damping. Waves with $\lambda > l$ are damped because of the presence of surface viscosity. (auth)

Superconductivity

Refer also to abstracts 27804, 28610, and 29126.

28544 (IS-T-585) MAGNETIC PHASE TRANSITIONS IN SUPERCONDUCTING VANADIUM. Haas, K. W. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 68p. Dep. NTIS $5.50.

Thesis.

The magnetization of very pure vanadium ($\rho_{300°K}/\rho_{4.2°K} = 1500$) was measured for reduced temperatures between 0.225 and 0.958 in order to study the nature of the phase transition at the lower critical field for this low-κ ($\kappa = 0.82$), long mean free path ($l \approx 60\ \xi_0$) material. The transition was analyzed to determine the equilibrium flux density, B_0, and the equilibrium flux-line lattice parameter, d_0, at initial flux penetration. The flux-line lattice parameter was found to agree well with the expression $d_0(t) = (1.73 \pm 0.1) \times 10^3$ Å $(1-t)^{-1/4}$. Critical field curves and generalized Ginzburg–Landau parameters were found to be in good agreement with earlier work by Sekula and Kernohan on less pure samples. (auth)

28545 (LBL-1840) PAIR-QUASIPARTICLE POTENTIAL DIFFERENCES IN CURRENT-CARRYING SUPERCONDUCTORS. Paterson, J. L. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 72p. Dep. NTIS $5.75.

Thesis.

An rf SQUID voltmeter was used to measure the potential difference between the quasi particles and pairs in the current-carrying superconductors tin and lead over the temperature range 1.3K to 4.2K. The results were compared with the theory by Tinkham which indicates that this potential difference results from a quasi-particle excitation spectrum branch imbalance or quasi-particle current in the superconductors. This branch imbalance relaxes in a characteristic time τ_Q. The measurements for tin confirm the theoretical volume and injection voltage dependences of the nonequilibrium potential V. The temperature dependence of τ_Q is seen to be in fair agreement with the theory near T_C and in excellent agreement at low temperatures. The magnitude of τ_Q near T_C of $1 \times 10^{-10}\ \Delta(O)/\Delta(T)$ sec is in good agreement with the theoretical estimate of $2 \times 10^{-10}\ \Delta(O)/\Delta(T)$ sec and in fair agreement with the results of Clarke of $3 \times 10^{-10}\ \Delta(O)/\Delta(T)$ sec. At low temperatures the data lie below the theory by an amount which is consistent with Tinkham's estimate of $Q^*/Q \sim 0.7$ for the branch imbalance parameters. The measurements for lead confirm the volume and injection voltage dependences of the nonequilibrium potential. The data near 4.2K agree with Tinkham's estimate of $\tau_Q \simeq 3 \times 10^{-12}$ sec but the increase in V below 4.2K is not understood. (auth)

28546 (ORNL-tr-2698) SUPERCONDUCTION OF TERNARY A-15 PHASES OF VANADIUM. Roeschel, E.; Raub, C. J. Translated from Metall; 26: No. 1, 29-34(1972). 13p. Dep. NTIS $3.00.

Measurements of the superconducting transition temperature and metallographic studies were made with alloys of the composition V_3A-V_3B (A, B = silicon, germanium, tin, aluminum, gallium). In the V–Ge–Ga and V–Ge–Al systems the greatest increases of the transition temperature (up to 14°K) were observed in heterogeneous germanium-rich alloys. The behavior of the tin-rich A-15 phase deviates from that of the other A-15 phases. Often a lattice volume expansion is accompanied by a decrease of the transition temperature. (auth)

28547 INTRINSIC RESISTIVE TRANSITION IN NARROW SUPERCONDUCTING CHANNELS. Lukin, V. P.; Tulub, A. V. Vestn. Leningrad. Univ., Geol., Geogr.; No. 1, 163-165(Feb 1973). (In Russian).

A theory of current-reducing fluctuations in narrow superconducting channels is considered based on the solution of the one-dimensional Ginzburg–Landau equation. The theory suggests

a new type of intermediate state by relatively large applied currents. This state consists of periodically placed normal and superconducting fractions. The stepwise dependence of the observed resistance upon the temperature is discussed. (auth)

28548 ULTRASONIC ATTENUATION IN NIOBIUM. 1. Purity Dependence in Normal and Meissner States, Measurements and Theory. Forgan, E. M.; Gough, C. E. (Univ. of Birmingham, Eng.). J. Phys., F (London); 3: No. 8, 1596-1620(Aug 1973).

Attenuation of 30 to 70 MHz longitudinal sound waves has been measured in both the normal and superconducting Meissner states from 1.2 K to 10 K for several crystals of niobium with resistance ratios 83 to 3880. This corresponds to measurements with $ql < 1$ (q is the sound wavevector and l the electron mean free path). These measurements are compared with the predictions of theoretical arguments appropriate for dealing with metals such as niobium which have complicated band structures. In the normal state an approximately T^{-3} term in the electron mean free path is observed which can be caused by interband scattering. On entering the superconducting state this contribution is modified and leads to deviations from the simple BCS behaviour. However, it is shown that the observed deviations are too large to be explained by this alone and theoretical arguments are developed which explain the deviations in terms of a mechanism (hitherto overlooked, but common to all superconductors) which will lead to an apparently purity dependent energy gap near T_c. At low temperatures the value of the energy gap deduced from the measurements falls in a way which is consistent with the known gap anisotropy, and there is no need to invoke the existence of a minority group of electrons with a very small energy gap. (auth)

28549 CONNECTION BETWEEN HIGH SUPERCONDUCTING TRANSITION TEMPERATURE, T_c, AND LATTICE INSTABILITY IN TRANSITION METAL COMPOUNDS: NbN. Gomersall, I. R.; Gyorffy, B. L. (Univ. of Bristol, Eng.). J. Phys., F (London); 3: No. 8, L138-L144(Aug 1973).

Using the result of a band structure calculation the electron–phonon mass enhancement factor λ for NbN is estimated. It is shown that the large λ and therefore the high T_c is due to the combination of two factors: (i) the small mass of the light nitrogen atoms and (ii) the strong scattering of electrons at the Fermi energy by the p resonance in the nitrogen scattering phase shifts. It is argued that in NbN as well as in other similar compounds (NbC, PdAgH), the large oscillations of a strong scattering light component give rise to a high T_c and signal the beginning of a lattice instability. For these high T_c compounds, the existence of what might be called the "second isotope effect" is predicted. (auth)

28550 FLUCTUATIONS IN SUPERCONDUCTORS. The Screening Approximation in Two Dimensions. Rickayzen, G.; Bray, A. J. (Univ. of Kent, Eng.). J. Phys., F (London); 3: No. 8, L134-L137(Aug 1973).

The screening approximation (Bray et al. J. Phys. F., Metal Phys.; 2: L109-13(1972)) for the treatment of fluctuations in superconductors is reconsidered in the two dimensional case. The approximation is an attempt to interpolate between the Hartree–Fock approximation, known to be correct at high temperatures, and the Hartree approximation, thought to be correct (it gives the same results as mean field theory) at low temperatures. The basic equations are solved within an approximation which treats large momenta correctly, the cut off being absorbed into a renormalization of the temperature variable. The specific heat is a universal function of the renormalized temperature variable and exhibits a peak. (auth)

28551 EFFECT OF PERPENDICULAR MAGNETIC FIELDS ON THE RESISTIVE TRANSITION OF SUPERCONDUCTING FILMS. Aoi, K.; Klenin, M. A. (Freie Univ., Berlin). J. Phys., C (London); 6: No. 16, L316-L319(20 Aug 1973).

A measurement of the fluctuation conductivity above the superconducting transition temperature in the presence of a perpendicular magnetic field for a clean aluminium film is reported. It is found that the Maki–Thompson (Maki, Prog. Theor. Phys.; 40: 193 (1968), Thompson, Proc. Int., Conf. Science of Superconductivity; 296(1971)) contribution is suppressed by a perpendicular field, in agreement with the recent calculation of Aoi, Meservey, and Tedrow (to be published). (auth)

28552 THIN FILM ARRAYS OF WEAKLY COUPLED SUPERCONDUCTING PARTICLES. Hansma, P. K. (Univ. of California, Santa Barbara). Solid State Commun.; 13: No. 3, 397-400(1 Aug 1973).

Thin film, macroscopic arrays of superconducting particles (e.g. of Sn) 100 to 10,000 Å in diameter can be produced by evaporating the superconductor in a gas at low pressure. The arrays have a critical supercurrent, I , which is a sensitive, multiply periodic function of the applied magnetic field. A simple model of multiple current paths through the array is proposed to explain both this observation and the general shape of the current–voltage characteristics. (auth)

28553 EXPERIMENTAL CONFIRMATION OF THE INFLUENCE OF LOCALIZED SPIN FLUCTUATIONS (LSF) ON SUPERCONDUCTIVITY. Prekul, A. F.; Rassokhin, V. A.; Volkenshtein, N. V. (Inst. of Metal Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 252-253(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 5, 354-356(5 Apr 1973).

On the basis of an experimental study of the temperature dependence of the resistivity in the alloy system Ti_x-V_{1-x} a relationship between the anomalous properties of these alloys was established. (MHR)

28554 EXCITATION SPECTRUM OF TYPE I SUPERCONDUCTORS IN HIGH MAGNETIC FIELDS. Grishin, A. M.; Yampolskii, V. A. (Inst. of Radiophysics and Electronics, Kharkov). Solid State Commun.; 13: No. 4, 447-452(15 Aug 1973).

The energy spectrum of surface excitations in type-I superconductors placed in a magnetic field is investigated theoretically. The case of strong fields has been considered when the renormalization of the gap near the superconductor's surface becomes essential. Then there arise excitations that are localized in a superficial layer comparable in thickness with the length of coherence ξ. For this case the energy density of states of the surface excitations has also been analyzed. (auth)

28555 SUPERCONDUCTIVITY AND STRUCTURAL INSTABILITY IN $SrTiO_3$. Allen, P. B. (State Univ. of New York, Stony Brook). Solid State Commun.; 13: No. 3, 411-415(1 Aug 1973).

Mattheiss (Phys. Rev.; B6: 4740(1972)) has recently calculated the effects of the 105°K structural phase transition on the conduction band and Fermi surface of $SrTiO_3$. The implications of this calculation for the microscopic understanding of superconductivity in $SrTiO_3$ are explored. In particular, coupling constants for electron–soft phonon interactions are evaluated. Certain pieces of Fermi surface are coupled very strongly to the soft mode which drives the structural instability, but these pieces are depopulated in the distorted phase. It is concluded that, contrary to a suggestion of Appel (Phys. Rev.; 180: 508 1969)), soft phonon modes do not affect superconductivity in $SrTiO_3$. (auth)

28556 SUPERCONDUCTING FLUCTUATIONS IN ONE-DIMENSIONAL ORGANIC SOLIDS. Bardeen, J. (Univ. of Illinois, Urbana). Solid State Commun.; 13: No. 3, 357-359(1 Aug 1973).

It is suggested that the superconducting fluctuations observed by Coleman et al. (Solid State Commun.; 12: 1125(1973)) just above the Peierls soft mode instability in pseudo one-dimensional organic solids is a reflection of Frohlich's one-dimensional model in which superconductivity arises from a coupling of the electrons with moving lattice waves rather than from a BCS type pairing. (auth)

28557 GINZBURG–LANDAU EQUATION WITH NON-LOCAL CORRECTION FOR SUPERCONDUCTORS IN ZERO MAGNETIC FIELD. Hook, J. R. (Univ. of Manchester, Eng.); Waldram, J. R. Proc. Roy. Soc. (London), Ser. A; 334: No. 1597, 171-192(28 Aug 1973).

A form of Ginzburg–Landau theory with nonlocal correction is derived which is useful in numerical calculation of the spatial variation of the order parameter for superconductors in zero magnetic field. This form of theory is obtained as an extension of the low temperature modifications of G–L theory developed by Werthamer and others, and is valid over a considerably wider range of values of temperature and order parameter. Boundary conditions at the interface between two metals applicable under rather general conditions are obtained, and the numerical calculation of the one-electron eigenstates in the presence of a spatially varying order parameter is discussed briefly in an appendix. (auth)

28558 MAGNETIC PROPERTIES OF LAMELLAR SUPERCONDUCTORS WITH WEAK INTERACTION BETWEEN THE LAYERS. Bulaevskii, L. N. (Lebedev Inst. of Physics, Moscow), Zh Eksp. Teor. Fiz.; 64: No. 6, 2241-2247(Jun 1973). (In Russian).

The magnetic properties of lamellar superconductors with Josephson interaction between the layers is considered. Differential-difference equations for the Ginzburg–Landau parameter in a magnetic field are obtained near the critical temperature. The vortex state in fields parallel to the layers is investigated on basis of the equations. The superconducting state is not destroyed in the center of the vortex filament at temperatures not too close to T_c but at the filament periphery the conditions are very similar to

those in a vortex filament of ordinary strongly anisotropic superconductors of the second kind. $H_{c1}(\|)$ is calculated and the structure of the vortex state is considered. It is shown that all temperatures not too close to T_c the magnitude of H_{c1} is determined by the paramagnetic effect and orbital motion of electrons within the layers in a field $H_\perp$. Thus in pure lamellar superconductors in parallel fields and at low temperatures an inhomogeneous state should exist and the field of transition to this state from the normal state at zero temperature is $\sqrt{2}H(0)$. (auth)

28559 DEVELOPMENT OF HARD SUPERCONDUCTORS, USING Nb–Ti AS EXAMPLE. Pt. 1. Hillmann, H. Metall; 27: No. 8, 797-805(1973). (In German).

From autumn course on supraconductivity and its application in electrical engineering and high-energy physics; Titisee, Germany (9 Oct 1972).

With the aim of developing superconductors for technical use, the aspects are presented for the concept of special types of conductors. Special consideration is given to the combined effect of the physical, metallurgical and technological aspects. The following problems are individually discussed and their technical solutions with examples are explained. Choice of the alloy and regulation of certain physical properties, in particular transition temperature T_c, above critical magnetic field H_{c2} and critical flow density j_c. Measures taken for stabilization. (GE)

28560 APPLICATIONS OF SUPERCONDUCTIVITY. Goodman, B. B. (British Oxygen Co., Ltd., London). Cesk. Cas. Fys.; 23: No. 5, 468-485(1973). (In Czech).

While, in the past, numerous applications of superconductivity have been suggested, those which now appear capable of competing effectively with other technologies are grouped into just three main areas. By far the most important at present is in the use of Type 2 superconductors to produce large dc (or slowly time dependent) magnetic fields for use in research, in novel types of electrical machinery and possibly in magnetically levitated trains. In this area the advantage of using superconductors appears to be greatest for large scale projects. Secondly superconductivity is of interest in two types of application which do not specifically require high fields, linear accelerators and power cables. Finally the Josephson effect is leading to the development of a rich harvest of electronic devices with unique properties of sensitivity and accuracy. Technological factors outside superconductivity are outlined in each case and an attempt is made to forecast which applications are likely the soonest to contribute to the building up of an industry based on superconductivity. (auth)

28561 NORMAL STATE RESISTANCE BEHAVIOR AND SUPERCONDUCTIVITY. Fisk, Z.; Lawson, A. C. (Univ. of California, San Diego, La Jolla). Solid State Commun.; 13: No. 3, 277-279(1 Aug 1973).

It is found experimentally that s-d superconductors have anomalous curvatures in the temperature dependence of the normal state resistivity. The materials reported on include the following: Zr_2Rh, U_6Fe, La_3Co, $Rh_{17}S_{15}$, $Pd_{17}Se_{15}$, La_3In, $LaIn_3$, LaB_6, YB_6. (auth)

28562 FLUX FLOW RESISTIVITY OF TYPE 2 SUPERCONDUCTORS. Cohen, G. S.; Rickayzen, G. (Univ. of Kent, Canterbury, Eng.). J. Phys., F (London); 3: No. 8, 1582-1595(Aug 1973).

The flux flow resistivity of type-II superconductors in low magnetic fields is calculated by a method that does not involve the rate of energy dissipation. Solutions for the local current density surrounding an isolated moving vortex are obtained from a time dependent Ginzburg–Landau equation, and the flux flow resistivity is calculated. The equations are then modified to include the effects of local temperature gradients that drive the entropy current and the resistivity is recalculated. Modifications due to the curvature of the vortices are included, and the relation of the transport current to the microscopic current density is examined in both the small field ($B \ll H_{c1}$) and intermediate field ($H_{c1} \ll B \ll H_{c2}$) regions. It is pointed out that the nonuniformity of the local current density implies a nonlinearity of the resistivity against B curve. (auth)

28563 MAGNETIC NUCLEATION FIELDS FOR A SUPERCONDUCTOR IN CONTACT WITH A NORMAL METAL. Martinoli, P. (Eidgenoessische Technische Hochschule, Zurich). Phys. Kondens. Mater.; 16: No. 1, 53-93(1973). (In French).

A theoretical and experimental investigation of the magnetic nucleation fields is presented for a superconductor in contact with a normal metal (proximity effect). The calculations are based on the de Gennes–Werthamer approximation for the pair potential $\Delta(r)$ and $T(c)$ (the transition temperature of the system) are known. Near a second order phase transition, the results are valid in the dirty limit and over the whole temperature range. The experiments deal with the parallel (H(c)(parallel)) and perpendicular (H(c)(perpendicular)) critical fields of Cu/Pb double layers as a function of the temperature and thickness of the Pb-film. Although the conditions for the dirty limit are not fulfilled by the specimens, it is possible to obtain a satisfactory description of H(c)(parallel) and H(c)(perpendicular) by a suitable interpretation of the coherence lengths. From these measurements an attractive electron–electron interaction g_n is deduced for copper. $g_n = +0.08 \pm 0.02$ is found from T(c) and $g_n = +0.04 \pm 0.02$ from H(c)(perpendicular). (GE)

28564 DISLOCATION INTERACTIONS AND SLIP IN A FLUX LINE LATTICE. Milne, I. (Central Electricity Research Labs., Leatherhead, Eng.). Phil. Mag.; 28: No. 1, 133-143(Jul 1973).

The distortion of flux lines in the vicinity of a dislocation in a flux line lattice is examined. With this knowledge the interaction of a dislocation with other flux line lattice defects such as interstitial flux lines, edge dislocations and screw dislocations is studied to determine how flux can flow through its own lattice. It is concluded that Frank–Read sources can only occur infrequently, but dislocation line expansion can occur extensively for certain interactions of a moving dislocation with a stationary screw dislocation. One of the products of this expansion is a dislocation dipole which is more mobile than a single dislocation but does not produce as much translation of the lattice. The significance of dislocations in a flux line lattice is discussed. (auth)

28565 MICROSCOPIC MAGNETIC FIELD DISTRIBUTIONS IN TYPE II SUPERCONDUCTORS BY NEUTRON DIFFRACTION. Ullmaier, H. (Kernforschungsanlage, Juelich, Ger.). Comments Solid State Phys.; 5: No. 3, 81-87(Mar 1973).

Reference is made to the Abrikosov (Zh. Eksper. Teor. 1442 (1957); Soviet Phys. JETP 5, 1174 (1957)) theory of superconductors with negative surface energy; this theory predicted the occurrence of a new phase, known as the Shubnikov phase or mixed state, characterized by a partial magnetic flux penetration, the flux being carried by quantized flux lines or vortices. Numerous measurements of macroscopic properties, e.g., magnetization, on type-II superconductors showed good agreement with calculations based on the theory, thus giving indirect proof for the correctness of the assumptions, but the first direct proof was due to Cribier and others (Phys. Lett., 9: 106(1964)) who performed a neutron diffraction experiment on superconductivity Nb in the mixed state, and found a diffraction peak at a position consistent with the existence of a triangular lattice of single quantized vortices. A discussion is presented directed to a detailed understanding of the mixed state, with particular reference to neutron diffraction studies. These studies are based on the interaction of the magnetic movement of the neutrons with the spatially varying magnetic fields of the mixed state structure. (UK)

28566 ATTRACTIVE INTERACTION BETWEEN VORTICES IN TYPE-II SUPERCONDUCTORS AT ARBITRARY TEMPERATURES. Leung, M. C. (Instutut Max von Laue, Garching, Ger.). J. Low Temp. Phys.; 12: No. 1-2, 215-235(Jul 1973).

It is shown that attractive interaction between vortices occurs when $\mathrm{Re}\,(\Lambda^{-1}) > \xi_0^{-1}$ for type-II superconductors with local or nonlocal magnetic effects, where $[\mathrm{Re}(1/\Lambda)]^{-1}$ and ξ_0 are, respectively, the decay length of the magnetic field and the order parameter at arbitrary temperatures. The interaction between vortices is attractive for all those type-II superconductors in which field reversal occurs, but field reversal is not a cause of attractive interaction. On the other hand, oscillatory behavior of magnetic fields contributes to attractive interaction. The critical values of the Ginzburg–Landau parameter, below which attractive interaction occurs, satisfy essentially the equation $\mathrm{Re}(\Lambda^{-1}) = \xi_0^{-1}$. (auth)

28567 THEORY OF DIRTY TYPE-II SUPERCONDUCTORS. Takayama, H. (Institut Max Von Laue, Garching, Ger.); Maki, K. J. Low Temp. Phys.; 12: No. 1-2, 195-214(Jul 1973).

A theory of dirty type-II superconductors is proposed, which describes the behavior of the vortex state not only in the high-field region but also in the intermediate-field region. The theory is constructed by taking into account the self-energy corrections to the electron Green function due to the presence of the spatially varying order parameter by the method similar to the one used previously by Brandt, Pesch, and Tewordt in their study of pure type-II superconductors. Making use of this Green function, thermodynamic as well as dynamic properties of dirty type-II superconductors are calculated, which describe quite well the observed behavior in the wider range of the vortex state. In particular, a sharp decrease of the flux-flow resistivity is obtained immediately below the upper critical field, while thermodynamic quantities vary smoothly in the same region. This accounts for the discrepancy so far found between the theory and the experiment for the flux-flow conductivity in the vortex state. (auth)

28568 DESTRUCTION OF SUPERCONDUCTIVITY IN INDIUM AND THALLIUM WIRES BY A CURRENT. Mukherjee, B. K.

(Univ. of St. Andrews, Scotland). J. Low Temp. Phys.; 12: No. 1-2, 181-193 (Jul 1973).

Several theoretical models have been put forward for the destruction of type-I superconductivity in a wire by the passage of a large enough current through it. In an attempt to discriminate between the various models, an experimental investigation has been carried out of the transition in one thallium wire and in a series of indium wires of different diameters and purity. The return of resistance in pure, thick thallium and indium wires is found to agree well with the predictions of the Baird–Mukherjee model. In thin wires the resistance increases with decreasing wire diameter, and the present experimental results are in reasonable agreement with the predictions made by Baird and Mukherjee who, following Kuper, have attributed the increase in resistance to the reflection of electrons at superconducting–normal interfaces. (auth)

28569 SUPERCONDUCTIVITY IN THE PRESENCE OF SHORT-RANGE MAGNETIC ORDER. Watson, H. L.; Keeler, W. J.; Beaudry, B. J.; Finnemore, D. K. (Ames Lab., IA). J. Low Temp. Phys.; 12: No. 1-2, 171-179 (Jul 1973).

Superconducting critical field curves were measured for $La_{98}Lu_{2-x}Tb_x$ alloys in a regime where the Tb ions show short-range magnetic order. The concentration dependence of the superconducting transition temperature and the critical field curves both show large deviations from the simple multiple pair-breaking theories and indicate the presence of substantial exchange fields. The onset of short-range order is very detrimental to superconductivity in this system. (auth)

28570 TEMPERATURE DEPENDENCE OF THE ELASTIC CONSTANTS OF NIOBIUM AND LEAD IN THE NORMAL AND SUPERCONDUCTING STATES. Trivisonno, J.; Vatanayon, S.; Wilt, M.; Washick, J.; Reifenberger, R. (John Carroll Univ., Cleveland). J. Low Temp. Phys.; 12: No. 1-2, 153-169 (Jul 1973).

The temperature dependence of the elastic constants of niobium and lead was measured in the normal and superconducting states. Both a continuous wave and a coherent gated-carrier technique were used to measure the velocity changes associated with the superconducting transition. The elastic constants were found to exhibit the same temperature dependence as the free energy in either state. The discontinuity in the modulus associated with longitudinal strains and the slope discontinuities at the transition temperature were used to calculate the strain dependence of the transition temperature. The strain dependence in all cases is mainly quadratic. (auth)

28571 SUPERCONDUCTING TO NORMAL TRANSITION OF TYPE-II Ta BY A RECTANGULAR CURRENT PULSE. Koga, S. (Electrotechnical Lab., Tokyo); Shibuya, Y. J. Low Temp. Phys.; 12: No. 1-2, 105-126 (Jul 1973).

The superconducting to normal transition by a rectangular pulse current in type-II Ta has been investigated. The potential drop along the specimen is observed as a function of time. The voltage pattern and the magnitude of the potential drop are obtained as functions of current amplitude, temperature, externally applied magnetic field, the angle between magnetic field and specimen axis, and k values. The transition mechanisms are discussed. It is also shown in this experiment that the flux flow or flux creep and flux jump occur. A support to the paramagnetic current flow in the presence of longitudinal magnetic field is given. (auth)

28572 CALCULATION OF PHONON-INDUCED GAP ANISOTROPY IN SUPERCONDUCTING Zn. Truant, P. T.; Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). J. Low Temp. Phys.; 12: No. 1-2, 31-47 (Jul 1973).

Leavens and Carbotte have given a microscopic theory of gap anisotropy applicable to the case of a weak-coupling superconductor. The theory relates the anisotropy in the gap directly to Fermi surface anisotropy and anisotropy in the electron–phonon interaction. Detailed calculations are presented of the phonon-induced anisotropy for the case of Zn. The gap is calculated for a dense set of points on the irreducible one-twenty-fourth of the Fermi surface. From this information the average gap and the pure single-crystal critical temperature are computed and compared with the dirty-limit case. The specific heat and spin-lattice relaxation are calculated as examples of thermodynamic properties. (auth)

28573 SUPERCONDUCTORS WITH CRYSTALLINE-FIELD SPLIT IMPURITIES: UPPER CRITICAL FIELD AND SPECIFIC HEAT. Keller, J. (Univ., Regensburg, Ger.); Fulde, P. J. Low Temp. Phys.; 12: No. 1-2, 63-70 (Jul 1973).

The investigation of crystalline-field effects on the properties of superconductors containing rare-earth impurities was continued. Attention is focused on impurities with a nonmagnetic ground state. The upper critical field H_{c2} and the jump of the specific heat at the phase transition are calculated. (auth)

28574 ULTRASONIC STUDY OF THE TRANSVERSE PHONON–ELECTRON INTERACTION IN THE SUPERCONDUCTING STATE OF HIGH PURITY NIOBIUM. Francavilla, T. L. Washington, DC; Catholic Univ. of America (1973). 111p. University Microfilms Order No. 73-21,100.

Thesis (Ph. D.).

The ultrasonic attenuation for transverse waves was measured in superconducting niobium as a function of temperature for different frequencies. Transverse ultrasonic waves are capable of establishing an electromagnetic field within the bulk of a superconductor. The character of this electromagnetic interaction has been studied with the result that anomalies have been found. These measurements offer direct experimental confirmation of the prediction, and provide direct evidence against the purity dependent energy gap model. (MHR)

28575 SCIENCE AND TECHNOLOGY OF SUPERCONDUCTIVITY. Volume 1. Proceedings of a Summer Course Held at Washington, DC, August 13–26, 1971. Gregory, W. D.; Mathews, W. N. Jr.; Edelsack, E. A. (eds.). New York; Plenum Publishing Corporation (1973). 476p. $22.50.

Thirteen lectures are included. Separate abstracts were prepared for 12. The paper "Josephson Effect in a Superconducting Ring" by F. Bloch previously appeared in NSA. (MHR)

For abstracts of individual chapters see: 28576–28586, and 28610.

28576 FUNDAMENTALS OF SUPERCONDUCTIVITY. Edelsack, E. A. (Office of Naval Research, Washington, DC). pp 5-24 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

A descriptive introduction to the fundamentals of superconductivity is presented. A panoramic survey of the major milestones in the development of the field is given. (MHR)

28577 PHENOMENOLOGICAL THEORIES OF SUPERCONDUCTIVITY. Gregory, W. D. (Georgetown Univ., Washington, DC). pp 25-70 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The following topics are covered: the basic facts of electromagnetism, the electromagnetic properties of superconductors, the extension of the normal metal constitutive relations, the magnetization picture, the current density picture; the London's equations, the implications of the London's theory; the constitutive relation for superconductors and flux quantization, nonlocal constitutive relations and ac effects, the basic facts of thermodynamics, the superconducting phase transition, the critical field curve, nonreversible effects; the surface energy problem, and two classical models for superconductivity; two-fluid theories and ordering theories. (MHR)

28578 ELEMENTS OF THE THEORY OF SUPERCONDUCTIVITY. Mathews, W. N. Jr. (Georgetown Univ., Washington, DC). pp 71-148 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

This study of the microscopic theory begins with a comparatively qualitative discussion of the problem which confronted BCS and the basic physical ideas which went into the solution of the problem. Then the Green's function formalism is presented. Finally, the Green's function formalism is applied to the problem of superconductivity. The primary concerns are the equilibrium properties and the response to a weak static magnetic field of a weak-coupling superconductor. (MHR)

28579 TIME-DEPENDENT SUPERCONDUCTIVITY. Scalapino, D. J. (Univ. of California, Santa Barbara). pp 163-183 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The consequences of charge conservation on time-dependent phenomena in superconductors are explored. Combined with the simple relaxation form of the time dependent Ginzburg–Landau equations, the demand of charge conservation implies that there is a charge buildup and a difference in the chemical potential of paired and unpaired electrons when there is a divergence of the supercurrent. As examples of the theory, the following are discussed: (1) the breakdown of the Josephson frequency condition, $2eV = h\nu$; (2) current flow across a normal-super interface; and (3) the dynamics of superconducting weak links. (auth)

28580 SUPERCONDUCTIVITY IN VERY PURE METALS. Gregory, W. D. (Georgetown Univ., Washington, DC). pp 211-261 of Science and Technology of Superconductivity. Vol. 1 Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The results of ac susceptibility experiments on the superconducting transition in pure gallium single crystals are presented and analyzed. The effect of boundary scattering on superconducting transition temperatures in indium and gallium was studied

and the results are discussed. Tunneling experiments on bulk gallium single crystals are discussed. (MHR)

28581 T_c's: THE HIGH AND LOW OF IT. Matthias, B. T. (Univ. of California, San Diego, La Jolla). pp 263-288 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

An informal explanation is given of how to discover superconductors, how to predict transition temperatures, and how to reach an understanding of superconductivity in a way different from that of the theorists. Emphasis is placed on superconductivity as a collective phenomena, that the number of unpaired electrons outside of the filled shell determines the superconducting transition temperature, and that cubic symmetry is necessary for superconducting compounds. (MHR)

28582 METALLURGY OF SUPERCONDUCTORS. Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). pp 289-332 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The structure and processing of superconducting materials play a dominant role in determining the critical current density, critical temperature, losses in ac fields at all frequencies, magnetic stability in large dc magnetic devices, reliability and durability of tunnel junctions and other useful and practical properties. Some of these effects are explainable via the Ginzburg–Landau–Abrikosov–Gorkov phenomenological theory with flux flow effects included; some are relatively crude matters of thermal and magnetic diffusivity; some are associated with surface topography on a submicroscopic scale; and some, including the critical temperature, are matters of conjecture. What is certain is that whether a superconducting material is useful at all depends crucially on how it is manufactured. The present and past status of practical and potentially practical materials, their properties, methods of fabrication and limitations, are reviewed and discussed. (auth)

28583 SUPERCONDUCTING INTERMETALLIC COMPOUNDS: THE A15 STORY. Hein, R. A. (Naval Research Lab., Washington, DC). pp 333-372 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The historical development of empirical rules for the fabrication of high T_c materials is covered briefly. The way these rules applied to A15 compounds is discussed. (MHR)

28584 THEORY OF SUPERCONDUCTING SEMICONDUCTORS. Koonce, C. S. (National Bureau of Standards, Washington, DC). pp 373-387 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The following are discussed: important normal state properties and superconducting energy gap equations. (MHR)

28585 ENHANCEMENT EFFECTS: THEORY. Koonce, C. S. (National Bureau of Standards, Washington, DC). pp 389-403 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

Interactions which occur inside three-dimensional inorganic solids under the influence of no outside fields are discussed. Theoretical limitations on the enhancement of T_c in superconductors are reviewed. (MHR)

28586 ENHANCEMENT EFFECTS. Schooley, J. F. (National Bureau of Standards, Washington, DC). pp 405-428 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

Various ways in which experimenters have attempted to generate high transition temperatures are discussed. The following methods are covered: the effects of alloying and impurities, T_c enhancement by compound formation, enhancement by variation in atomic order, enhancement by variation in electron density, enhancement by proximity effects, enhancement by varying sample dimensions, and enhancement by pressure. (MHR)

28587 SCIENCE AND TECHNOLOGY OF SUPERCONDUCTIVITY. Volume 2. Proceedings of a Summer Course Held at Washington, DC, August 13–26, 1971. Gregory, W. D.; Mathews, W. N. Jr.; Edelsack, E. A. (eds.). New York; Plenum Publishing Corporation (1973). 392p. $22.50.

Separate abstracts were prepared for the 12 lectures. (MHR)

For abstracts of individual chapters see: 28588 and 28611–28621.

28588 MILLIMETER AND SUBMILLIMETER DETECTORS AND DEVICES. Shapiro, S. (Univ. of Rochester, NY). pp 631-652 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

Some of the basic principles underlying the applications of the ac Josephson effect are reviewed. In particular an attempt is made to show why the Josephson effect can be used as a far-infrared detector and mixer, how it has been used up to now in the laboratory, and what some of the inherent and practical limitations are to attainable performance. An ideal Josephson junction is studied first. Modifications of the concept of the ideal junction in order to understand the electrical characteristics of real junctions and the effect that measuring circuitry has on the observed characteristics of real junctions is touched on briefly. A commentary on the directions in which future work is desirable is given. (MHR)

28589 STRUCTURES AND PROPERTIES OF SUPERCONDUCTING MATERIALS. Fradin, F. Y.; Neumann, P. (Argonne National Lab., IL). pp 231-278 of Treatise on Materials Science and Technology. Vol. 2. Herman, H. (ed.). New York; Academic Press, Inc. (1973).

A critical review is presented of a number of properties of superconductors that depend heavily on both the ideal and the defect structure of materials. Both type-I and -II superconductivity are covered. Transition-metal superconductors are considered in detail (metallurgy, theory, and physical properties). Mechanisms involved in flux pinning are reviewed. (22 figures, 216 references) (DLC)

28590 SUPERCONDUCTOR NbTi DEVELOPED IN CZECHOSLOVAKIA. Cesk. Cas. Fys.; 23: No. 5, 515-516(1973). (In Czech).

A short characteristic of monofilamentary superconducting NbTi wires with $T_c = 9.2$ K, $B_{c2} = 12$ T and $j_c = (1.4 \div 2) \cdot 10^5$ A/cm^2 at 5 T is given. (auth)

28591 ELECTRON THERMAL CONDUCTIVITY OF THIN FILMS OF STRONG-COUPLING SUPERCONDUCTORS AND OF SUPERCONDUCTORS CONTAINING RARE EARTH IMPURITIES. Mrstik, B. J. Urbana, IL; Univ. of Illinois (1973). 144p. University Microfilms Order No. 73-17,607.

Thesis (Ph. D.).

The thermal conductivity of several superconducting films was measured. These films were evaporated onto substrates held at liquid helium temperatures, and therefore the phonon mean free path in these films was very short. Consequently, the phonons contributed very little to the thermal conductivity. The experimentally determined thermal conductivity was therefore due almost entirely to the conduction of heat by the electrons. The electron thermal conductivity K_{es} of a strong-coupling superconductor and of superconductors containing rare earth impurities has been measured in this way. The theoretical expression for K_{es} of strong-coupling superconductors was generalized to include elastic scattering of the electrons. When elastic scattering of the electrons dominates, the expression for K_{es} reduced to that of Bardeen, Rickayzen, and Tewordt, except for a change in the energy gap width. These results are in good agreement with the experimental measurements on a quench-condensed film of lead. The thermal conductivity of thin films of lead or indium containing small amounts of gadolinium was also measured. These results are in good agreement with theoretical results of Ambegaokar and Griffin (modified for strong-coupling effects), except at very low temperatures. It is believed that the low temperature deviations are related to the properties of the substrate, rather than to the characteristics of the superconducting films. (Diss. Abstr. Int., B)

28592 INVESTIGATION OF SUPERCRITICAL HEAT FLOW IN HELIUM II. Dimotakis, P. E. Pasadena, CA; California Inst. of Tech. (1973). 105p. University Microfilms Order No. 73-18,370.

Thesis (Ph. D.).

To investigate the validity of appending the Gorter–Mellink friction term to the equations of motion of liquid helium the temperature was measured along the axis of a channel carrying a supercritical heat current. A single thermometer on a traversing assembly was used permitting local measurements both in the interior of the channel and in the jet formed in the free fluid. The temperature gradient in the interior of the channel is found to be in agreement with the Gorter–Mellink law up to the lambda point, but goes to zero within a channel diameter, in the free jet. Since the relative velocity between the two fluids is probably continuous along the axis of the jet in the vicinity of the exit, the disappearance of the temperature gradient appears to be inconsistent with the predictions of the Gorter–Mellink term. The Gorter–Mellink A(T) was also measured up to the lambda point. A much stronger divergence is found as $T\lambda$ is approached than was indicated by previous measurements. (Diss. Abstr. Int., B)

28593 FLUXON COUPLING IN SUPERCONDUCTING DC TRANSFORMERS. Lindstrom, W. A. Clemson, SC; Clemson Univ. (1972). 56p. University Microfilms Order No. 73-19,272.

Thesis (Ph. D.).

The coupling parameter $(V_s/V_p)_0$ was measured for superconducting dc transformers as a function of the separation of the two films and of the thickness of the primary film. In all experiments

both the primary and secondary films were of tin, and the secondary film thickness was fixed at 200 nm. The tin films were separated by a layer of silicon monoxide. With the primary film thickness fixed at 400 nm, $(V_s/V_p)_0$ decreased from one to zero as the separation increased from 500 to 1200 nm. With the separation fixed at 30 nm, $(V_s/V_p)_0$ decreased from one to zero as the primary film thickness decreased from 75 nm to 45 nm. An experimental determination of the maximum coupling force on a fluxon in the superconducting dc transformer was made by depressing $(V_s/V_p)_0$ to zero by applying a current in the secondary film antiparallel to the primary film transport current. Comparison of this experimental maximum coupling force per fluxon to a theoretical maximum coupling force per fluxon for an isolated fluxon showed the experimental values to be less than the theoretical values by a factor of ten. (Diss. Abstr. Int., B)

28594 HIGH TEMPERATURE ELECTRIC RESISTANCE AND THE SUPERCONDUCTIVITY OF POTASSIUM AND RUBIDIUM AT HIGH PRESSURES. Gandel'man, G. M.; Itskovich, O. Yu.; Kondratenko, P. S.; Perstnev, I. P.; Finkel'berg, V. M. Zh. Eksp. Teor. Fiz.; 65: No. 1, 226-236(Jul 1973). (In Russian).

The growth of the high temperature electric resistance of K and Rb on compression is explained by electron rearrangement expressed in a change of the relative positions of the s- and d-bands in the conductivity band which leads to an increase in localization of the conductivity electrons. The specific resistance ρ is calculated on basis of data on the wave functions and structure of electron bands obtained in the Wigner–Seitz spherical approximation. The calculated dependence of ρ on degree of compression possesses a maximum which coincides with the beginning of filling up of the d-bands. The K and Rb superconductivity parameters as a function of compression are calculated in the same approximation. The superconducting transition of K (at P ~ 150 kbars) and Rb (at P ~ 100 kbars) is predicted quantitatively. The main cause of appearance of superconductivity in these metals is rearrangement of the electron spectrum on compression. (auth)

28595 CONDUCTIVITY OF SUPERCONDUCTORS OF THE SECOND KIND NEAR THE TRANSITION TEMPERATURE. Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 290-296(Jul 1973). (In Russian).

The conductivity of superconductors of the second kind is investigated in the vicinity of the critical temperature. A broad region of magnetic field strengths near the critical field exists in which corrections in the following order in the conductivity should be taken into account due to the numerically small coefficient in the leading term. (auth)

28596 VISCOUS FLOW OF VORTEXES IN SUPERCONDUCTING ALLOYS OF THE SECOND KIND. Gor'kov, L. P.; Kopnin, N. B. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 396-410(Jul 1973). (In Russian).

General kinetic equations for viscous flow of separate filaments are obtained on basis of the microscopic theory of superconductivity for a low vortex velocity $u/\xi \ll \Delta$ and not very large filament density ($H \ll H_{c2}$). The relation between the transport current and filament velocity is derived. The general equations are solved numerically for $T \ll \Delta$; the conductivity of a "dirty" superconducting alloy with a vortex structure is $\sigma_{eff} = 0.9\ \sigma H_{c2}/B_0$. (auth)

28597 SUPERCONDUCTIVITY AND THE KONDO EFFECT. Ludwig, A. Montreal; McGill Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The properties of superconductors that exhibit the Kondo effect in the normal state are investigated. An expression for the superconducting critical temperature as a function of the concentration of magnetic impurity is derived. The effect of magnetic impurities on the resistive transition of superconductors is investigated. The superconducting proximity effect is used to study normal metals containing magnetic impurities. The effect of electron correlations on the Falicov–Kimball model (1969) for the metal-insulator transition is studied. (Diss. Abstr. Int., B)

28598 NUCLEAR QUADRUPOLE SPIN–LATTICE RELAXATION OF ^{181}Ta IN TYPE-II SUPERCONDUCTING Ta_3Sn. Wada, S. (Kobe Univ., Japan); Asayama, K. J. Phys. Soc. Jap.; 34: No. 5, 1168-1179(May 1973).

Following the discovery of the NMR signal of ^{181}Ta in Ta_3Sn, the ^{181}Ta and ^{119}Sn nuclear spin–lattice relaxation rates were studied in its superconducting mixed state. The relaxation rate of ^{119}Sn shows a clear dip just below $T_C(H)$ which typifies the magnetic relaxation rate, where $T_C(H)$ is the transition temperature corresponding to the external magnetic field, H. In contrast, the relaxation rate of ^{181}Ta drops rapidly just below $T_C(H)$ and then decreases monotonically with decreasing temperature. It is shown that this relaxation behavior is attributed predominantly to the quadrupole relaxation mechanism. In order to obtain a good agreement between the experimental data and the theoretically calculated value of BCS Case I, one is led to estimate the quadrupole relaxation rate to be three times as large as the magnetic relaxation rate in ^{181}Ta relaxation. (auth)

28599 MISALIGNMENT OF FLUX LINES IN A TYPE-II SUPERCONDUCTOR STUDIED BY NEUTRON SMALL-ANGLE DIFFRACTION. Lippmann, G.; Schelten, J.; Hendricks, R. W.; Schmatz, W. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (b); 58: No. 2, 633-641(1 Aug 1973).

The mutual misalignment of flux lines was measured in Nb by neutron small-angle diffraction with the incident beam parallel to the flux lines. The resolution function of the apparatus for this new geometry was evaluated and various physical contributions to the broadening of the observed diffraction peaks are discussed. The resulting misalignment angles were found to be largest (≈4°) at low flux densities, and decreased to a constant value (8′ ± 5′) at flux densities larger than 0.5 H_{c2}. (auth)

Equipment and Devices

28600 ELIMINATION OF SIDEBANDS DUE TO THE ROTATION OF THE SAMPLE IN AN NMR SPECTROMETER HAVING A HIGH RESOLUTION WHICH INCORPORATES A SUPERCONDUCTING MAGNET. Zabrodin, V. A.; Krainskii, I. S.; Nazarov, V. B.; Gal'perin, L. N. (Inst. of Chemical Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 269-270 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 220-221(1973).

The improvement of previously described devices for compensating the nonuniformity of the magnetic field of a solenoid is proposed. An additional pair of compensators is introduced for compensating the gradients $\partial^2 H_{0z}/\partial(x^2 - y^2)$ and $\partial^2 H_{0z}/\partial(xy)$. These measures allowed a resolution of an NMR spectrometer with a superconducting magnet to be obtained which was better than $5 \cdot 10^{-9}$ (1 Hz) in a standard 5-mm ampule for a level of the sidebands produced by sample rotation equal to ~1% of the main signal. (auth)

28601 EFFECT OF THE INTRINSIC MAGNETIZATION OF THE WINDING MATERIAL ON THE FIELD DISTRIBUTION IN A SUPERCONDUCTING SOLENOID. Baranov, I. A. Vasil'chenko, V. F.; Kupchinova, G. A.; Kupchinov, N. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 1, 271-273(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 1, 222-224 (1973).

Modulation in an electrolytic tank was used to investigate the effect of the intrinsic magnetization of superconductors on the field distribution on the axis of solenoids. It was shown that for a field of ~3T this effect is substantial and depends on the variations of the basic field and likewise on the geometry of the solenoid. (auth)

28602 IMPROVEMENTS IN AND RELATING TO ROTARY ELECTRICAL MACHINES. Macnab, R. B.; Ross, J. S. H.; Wood, M. B. (to International Research and Development Company Ltd.). British Patent 1,315,302. 2 May 1973. Filed date 10 Jun 1969. 6p.

Reference is made to rotary electrical machines having superconducting windings. A synchronous ac machine is described having within its stator a hollow rotor of nonmagnetic material carrying a superconducting dc winding. The rotor is cylindrical in construction, with hollow transition members connecting the ends of the cylindrical body to end shafts. Means are provided for supplying cryogenic fluid to the winding and transition members, and a thermal radiation shield surrounds the cylindrical body. The hollow transition members may be of frustoconical form and may be evacuated—as also may the whole of the rotor interior. A compressor and primary refrigeration state is provided outside the rotor, connected to supply cryogenic fluid to a refrigeration stage inside the rotor and to coils for cooling the transition members. The superconducting winding may be disposed on the rotor to produce a sinusoidally varying radial field. The stator may incorporate a magnetic shield. (UK)

28603 SUPERCONDUCTING MACHINES. A New Era for the Electrical Power Industry. Appleton, A. D. (International Research and Development Co. Ltd., Fassway, Eng.). Phil. Trans. Roy. Soc. London, Ser. A; 275: No. 1248, 77-84(30 Aug 1973).

The development of superconducting dc machines is discussed with particular emphasis on industrial applications. Illustrations of the superconducting marine propulsion system now under construction are given. Advantages to be gained from the successful development of superconducting ac generators are indicated. It is concluded that the technology of niobium–titanium supercon-

ductors has reached the point where the requirements of rotating electrical machines can be achieved and the associated technology of helium refrigerators has the status necessary to give full support to the development of electrical machines. Substantial benefits are available from superconducting dc motors and generators which are already at an advanced stage of development. The major factor which is preventing the widespread introduction of these machines to industry is operating experience and confidence, and this may be achieved only by the construction of pre-production machines for evaluation. (UK)

28604 SUPERCONDUCTING MAGNETS: GENERAL PROPERTIES AND STATE OF THE ART IN THE CSSR. Cesnak, L. (Electro-Technical Inst., Bratislava). Cesk. Cas. Fys.; 23: No. 5, 486-500(1973). (In Czech).

The fundamental properties of superconductors and superconducting magnets are discussed. The characteristics of Nb–Ti and Nb_3Sn superconductors are compared and their manufacturing technology and methods of stabilization are described. The importance of the average overall current density particularly in small laboratory type magnets is pointed out. The unfavorable consequences of the quenching process of superconducting magnets are briefly mentioned. Attention is given to new developments in CSSR and the results achieved are compared with the world standard. (auth)

28605 PRECISE SUPERCONDUCTING DC RATIO TRANSFORMER. Harvey, I. K. (National Standards Lab., Sydney). Phys., E (London); 6: No. 9, 812-813(Sep 1973).

An improved design for a precise superconducting dc ratio transformer is described in which dc ratios with accuracies better than 0.01 ppM have been achieved. (auth)

28606 SUPERCONDUCTING RECIPROCATING MACHINES. Harrowell, R. V. (Central Electricity Research Labs., Leatherhead, Eng.). Phil. Trans. Roy. Soc. London, Ser. A.; 275: No. 1248, 85-94(30 Aug 1973).

The superconducting reciprocating generator/motor has several advantages over the machines with rotating superconducting field windings on which most existing work is concentrated. It consists essentially of a number of armature conductors oscillating within a superconducting solenoid of rectangular cross section, the conductors being parallel to the long side of the rectangle and at right angles to the directions of both the field and the movement. In the three-phase version the solenoid is wrapped into a toroidal shape, each armature phase being situated at an angle of 120° to its neighbour. The electrical phase relation is maintained by linking each phase-set of conductors through a connecting rod to a crank on the drive shaft. Electrical contact between the armatures and fixed terminals is made through flexible connectors. The chief advantages of the new machine are: 1. The superconducting field winding is stationary, while the armature does not require sliding contacts to carry the large output current. 2. The field flux is completely contained within the toroid without the need for iron or copper screens. 3. Because the armature conductors do not rotate, but reciprocate in the uniform toroidal field, it is possible to make them of superconductor since the ac losses, being due only to the self-field of the armature current, are tolerable. Even with normal conductors, eddy-current losses are greatly reduced. Optimization of the design, the problem of fatigue, seals and bearings, losses, and reactances are discussed. As the main disadvantage of this machine lies in the linkage converting rotary to linear motion, the prospect of an all-reciprocating system is mentioned. (auth)

28607 SUPERCONDUCTING CABLES FOR AC AND DC POWER TRANSMISSION. Baylis, J. A. Phil. Trans. Roy. Soc. London, Ser. A; 275: No. 1248, 205-224(30 Aug 1973).

The growth of electricity demand has led to a steady increase in the power-carrying capacity of underground power transmission lines. Some present cables are water cooled to increase their current rating, and further increases could be achieved by refrigerating the conductors to reduce their resistivity. The ultimate and best use of refrigeration is to cool to a few Kelvins above absolute zero so that superconductors can be used. The technical problems of both ac and dc superconducting cables are described, with particular attention to the choice of superconductor and the choice of dielectric. The conductor choice is heavily influenced by fault current requirements. Some possible cable designs are then discussed, and present progress toward such designs briefly summarized. The electrical parameters of superconducting cables are deduced, and tentative economic assessments put forward. For high-power levels, exceeding 2 GVA, superconducting cables may offer real advantages; on the other hand, it may be 20 years before substantial requirements for such cable will arise. (auth)

28608 SUPERCONDUCTIVE CABLE FOR CARRYING EITHER ALTERNATING OR DIRECT CURRENT. Aupoix, M.; Frackhauser, F. M.; Royet, J. (to Compagnie Generale d'Electricite). U. S. Patent 3,754,095. 21 Aug 1973. Priority date 26 Dec 1968, France. 4p.

A cable for cryogenic connection is described having one or more pairs of conductive layers insulated electrically from each other and consisting of several superconductors arranged in spiral formation over the opposing surfaces of the conductive layers. (auth)

28609 50 KG GAS COOLED SUPERCONDUCTING SOLENOID OPERATED AT 13°K. Stevenson, R. (McGill Univ., Montreal). Cryogenics; 13: No. 9, 524-525(Sep 1973).

To evaluate the feasibility of operating a large superconducting device at temperatures above that of liquid helium, a gas cooled superconducting solenoid operating at 13°K has been tested. Details of construction and operation are given. The main advantage of such a mode of operation is the reduced expense of refrigeration. The gas cooling technique was found to be a simple and effective method for the operation of large superconducting devices at high fields and is considered to be superior to the use of liquid helium. Ni–Sn is capable of carrying appreciable current densities at high fields and elevated temperatures. The superconductor also becomes stable under these conditions allowing pulsed operation of such devices. (UK)

28610 REFRIGERATION FOR SUPERCONDUCTING DEVICES. Stuart, R. W. pp 185-205 of Science and Technology of Superconductivity. Vol. 1. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The following are described: (1) the ways by which refrigeration can be produced, (2) some generalized refrigerator characteristics, and (3) some examples of refrigeration systems which would be appropriate for superconducting devices. (MHR)

28611 SUPERCONDUCTING POWER TRANSMISSION. Meyerhoff, R. W. (Union Carbide Corp., Tarrytown, NY). pp 433-458 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The present state-of-the-art of superconducting underground power transmission is reviewed. (MHR)

28612 APPLICATION OF SUPERCONDUCTIVITY IN THERMONUCLEAR FUSION RESEARCH. Martinelli, A. P. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). pp 459-481 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The application of superconductivity to controlled fusion research at Max Planck Institute of Plasma Physics is described, i.e., mainly in the quadrupole and stellarator experiments, which are respectively under construction and at the advanced planning stage. First, the recent technological progress in the field of superconducting materials is reviewed and the most important experiments in Western Europe and the United States using superconducting magnets are examined briefly. The part to be played by superconducting magnets in possible future thermonuclear reactors is outlined. (MHR)

28613 APPLICATION OF SUPERCONDUCTORS TO MOTORS AND GENERATORS. Smith, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge). pp 483-496 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The potential of superconductors is illustrated by examining the limitations of conventional machines and then evaluating how superconductors can advance these limits. (MHR)

28614 SUPERCONDUCTING COILS. Stekly, Z. J. J. (Magnetic Corp. of America, Cambridge, MA). pp 497-537 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The common characteristics of superconducting coils that bear little physical resemblance to one another are discussed. The following topics are discussed: superconductors, stabilization of the superconductors, available conductors, conductor and coil performance, structure, state-of-the-art, specific applications, steady state stability, and structural requirements. (MHR)

28615 PHYSICS OF SUPERCONDUCTING DEVICES. Deaver, B. S. Jr. (Univ. of Virginia, Charlottesville). pp 539-564 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

A brief overview is given of the many applications of superconductivity. The physics is discussed of that subset of applications sometimes called "quantum devices", that is, those involving fluxoid quantization, flux flow, and the Josephson effect. (MHR)

28616 SUPERCONDUCTIVITY IN DC VOLTAGE METROLOGY. Finnegan, T. F. (National Bureau of Standards, Washington, DC). pp 565-585 of Science and Technology of Super-

conductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The use of the ac Josephson effect via Te/h to maintain a unit of voltage or more precisely electrochemical potential is considered in detail here. The future role of the cryogenic potentiometer (voltage divider) and superconducting voltmeter (galvanometer) in a Josephson-effect voltage standard is also explored, and a possible secondary voltage standard based on Giaver tunneling is described. (MHR)

28617 ELECTRIC AND MAGNETIC SHIELDING WITH SUPERCONDUCTORS. Cabrera, B. (Stanford Univ., CA); Hamilton, W. O. pp 587-605 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The properties of superconductors which enable them to be such perfect shields are reviewed briefly. Measurement techniques in low field regions and the most recent work on magnetic shielding are discussed. Finally, some applications of these shielding techniques are mentioned. (MHR)

28618 SUPERCONDUCTIVE COMPUTER DEVICES. Matisoo, J. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). pp 607-623 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

After considering some necessary and desirable properties of computer devices in general, the basic ideas underlying all superconductive computer devices are discussed. Thin film cryotrons, simple logic and memory circuits, and proposed or existing systems are discussed briefly. The Josephson tunnel junction devices, which are more recent and have considerable potential, are discussed in more detail. (MHR)

28619 SUPERCONDUCTORS IN THERMOMETRY. Schooley, J. F. (National Bureau of Standards, Washington, DC). pp 625-630 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

Several properties of superconductors that have found some actual use either as thermometers or detectors in thermometry are examined. Topics covered are: heat capacity, critical magnetic field, superconducting transition temperature, superconducting junction tunnel current, and noise thermometry. (MHR)

28620 MAGNETOMETERS AND INTERFERENCE DEVICES. Webb, W. W. (Cornell Univ., Ithaca, NY). pp 653-677 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

The mechanisms and operation of one class of superconducting flux sensors are described in elementary terms using the basic properties of superconductors. The operation of the most popular present device is outlined, and instrument configurations for measurements of magnetic fields, magnetic susceptibility, voltage, and resistance are described. Noise problems and other limitations of the instruments are discussed briefly and some applications and possibilities for the future are discussed. (MHR)

28621 TECHNOLOGICAL IMPLICATIONS OF SUPERCONDUCTIVITY IN THE NEXT DECADE. Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). pp 719-733 of Science and Technology of Superconductivity. Vol. 2. Gregory, W. D. (ed.). New York; Plenum Publishing Corp. (1973).

An attempt is made to answer the following questions: (1) What knowledge and demonstrated capabilities in the field of superconductivity are there now? (2) What can be done with superconductivity within the next decade, given sufficient effort and support? (3) What should be done with it? (MHR)

28622 MACROSCOPIC QUANTUM EFFECTS IN SUPERCONDUCTING RINGS CONTAINING TWO JOSEPHSON JUNCTIONS. Wilson, J. G. Buffalo; State Univ. of New York (1973). 155p. University Microfilms Order No. 73-19,255.

Thesis (Ph. D.).

The behavior of a macroscopic quantum interferometer was investigated experimentally. The quantum interferometers studied consisted of an evaporated tin ring containing two Josephson tunneling junctions symmetrically located in the ring which was cooled to 1.2°K so that the tin was superconducting. Substantial improvements were made over past quantum interferometers in four areas: 1. The dimensions of the ring were well known. 2. The ring was constructed such that the applied magnetic field would enter the ring and not the Josephson junctions, so no complications resulting from flux in the junctions occurred. 3. The Josephson tunneling junctions used in the ring were ideal from the standpoint of exhibiting the behavior predicted by the Josephson equations. 4. A new technique was developed which allowed one to "trap" the ring in a pre-selected quantum state and study its dynamic behavior in the presence of magnetic field changes. A discussion of the junction preparation techniques and the static and dynamic theories of junctions in a ring are presented. The concluding sections present the results of the experimental investigations. The results showed direct experimental confirmation of the quantization of the fluxoid in a ring with two Josephson junctions. The quantum states of the ring are shown to be highly stable, contradicting some previously held ideas. First of its kind data is given showing the nature of the interaction of two junctions in a ring. (Diss. Abstr. Int., B)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 27900 and 28640.

28623 (COO-2280-1) FINITE ELEMENTS IN NEUTRON TRANSPORT THEORY. Bareiss, E. H.; Abu-Shumays, I. K. (Northwestern Univ., Evanston, Ill.). May 1973. Contract AT(11-1)-2280. 56p. Dep. NTIS $5.00.

An assessment of current multidimensional neutron transport theory calculations is made with respect to the use of large computational cells or finite elements. It is shown that many variational methods exist to accomplish a given job. The symmetrization processes are compared, and the Vladimirov–Lagrange functional is derived. The numerical behavior is discussed, and illustrated by examples in tables and graphs, together with finite difference calculations for identical problems. Because of the great variety of numerical techniques to solve neutron transport problems, a rating of these methods is necessary to minimize development and user's cost. A general, systematic evaluation procedure is described of which a computerized version is under development at Northwestern University. The importance of knowing the analytic behavior of the mathematical solution to achieve computational efficiency is demonstrated by numerical examples and the behavior at corners is analyzed in phase-space. Using the S_N-methods as an example it is shown that the global behavior of the numerical solutions can be predicted from individual matrix blocks. Also by example it is shown that great computational economy can be achieved by using space and angular approximations in a predetermined appropriate relation. (auth)

28624 (COO-2280-2) ADJOINING APPROPRIATE SINGULAR ELEMENTS TO TRANSPORT THEORY COMPUTATIONS. Abu Shumays, I. K.; Bareiss, E. H. (Northwestern Univ., Evanston, Ill.). May 1973. Contract AT(11-1)-2280. 47p. Dep. NTIS $4.50.

Neutron density possesses logarithmic singularities in its derivatives near material interfaces (discontinuities) and vacuum boundaries. Singularities also exist near edges and corners, and can be shown to propagate to the interior regions. The accuracy and the rate of convergence of higher order approximations are affected by the choice of mesh spacing, and depend critically on how well the local behavior near boundaries and edges is accounted for. Considerable information can be obtained, as is done below, through the study of one-energy-group slab geometry model problems for the integral transport equation. Here, variational methods are applied to the Milne problem, a source problem based on the Milne problem, and the slab eigenvalue and the extended eigenvalue problem. In the first problem the Galerkin technique is used with the exponential integrals as base functions. The results are improved especially close to the interface by a first iteration as indicated by Kourganoff. For the source problem, linear and cubic spline bases are used. It is shown that considerable improvement is gained by adjoining to the trial function in the first interval an x log x "add-on term" to allow for the analytic behavior near the interface. In particular for small n ($n < 32$), addition of the x log x term is often better than doubling the mesh size; furthermore the linear results with the x log x term are better than the uncorrected cubic results without this term. The advantage of a nonuniform mesh (dense close to the interface and sparse in the regular region) is also demonstrated. In the third problem, simple trial functions for the criticality problem already used in the literature are applied, but better accuracy is achieved both with and without the x log x term. In conclusion, a recommendation is made as to how to approach two and three dimensional problems. (auth)

28625 (COO-2280-3) COMPUTATIONAL COMPLEXITY IN MULTIDIMENSIONAL TRANSPORT THEORY CALCULATIONS. Progress Report, September 1, 1972–August 31, 1973. Bareiss, E. H.; Abu-Shumays, I. K. (Northwestern Univ., Evanston, Ill.). May 1973. Contract AT(11-1)-2280. 14p. Dep. NTIS $3.00.

The scope of this research is to develop highly efficient methods for neutron transport theory calculations. To achieve this goal, a method is developed to evaluate the reliability and effectiveness of existing and proposed new methods at low cost. The report summarizes the state of the present program and results already obtained, which promise significant savings of computation time and code development costs. (auth)

28626 (INR-1405/21) EFFECT OF SINGULARITIES ON APPROXIMATION IN S_N METHODS. Arkuszewski, J.; Kulikowska, T.; Mika, J. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 25p. INIS.

The discrete ordinate transport equation in two-dimensional rectangular geometry is analyzed. The exact solution is shown to exhibit singularities at the so called singular characteristic even for arbitrarily smooth cross section, source and external boundary conditions. The box explicit method is proposed and used to investigate numerically the effect of the singular characteristic. (auth)

28627 PERTURBATION THEORY IN CALCULATIONS OF THERMAL NEUTRON UTILIZATION FACTOR. Peskov, R. P. At. Energ. (USSR); 33: No. 5, 914-915(Nov 1972). (In Russian).

This paper was summarized as paper No. 619/6624 with full copy held at TIC.

Perturbation theory is developed within the framework of the albedo method for calculating variations of the thermal neturon utilization factor in multiregion annular cells. The problem is formulated in the multigroup scheme with thermalization of neutrons taken into account. Numerical examples are cited for the one-group case, illustrating the high accuracy of the method proposed in the face of appreciable variations in absorption cross sections in the different zones of the cell. (MHR)

28628 EXTRAPOLATED ENDPOINTS IN THE TWO-GROUP THEORY OF NEUTRON DIFFUSION. Siewert, G. E. (Univ., Karlsruhe, Ger.). J. Nucl. Energy; 27: No. 8, 553-558(Aug 1973).

The use of an extrapolated-endpoint boundary condition in criticality calculations is discussed from the point of view of two-group neutron transport theory. The use of a single Milne Problem extrapolated endpoint is justified, from the lowest-order approximation to the transport theory result, only for certain values of the material properties of a bare multiplying slab. (auth)

28629 SIMPLE CALCULATION OF THE TIME DEPENDENCE OF THE SECOND SPATIAL MOMENT. Pomraning, G. C. (Science Applications, Inc., La Jolla, CA). Nucl. Sci. Eng.; 52: No. 1, 144-145(Sep 1973).

Consider one-speed neutron transport in an infinite medium. Let a neutron be released from the origin at time zero. Previously a probabilistic argument was used to derive an exact expression, for an arbitrary scattering law, giving the neutron's mean square distance from the origin as a function of time. This result can be derived in a much simpler manner by merely forming the appropriate spatial and angular moments of the transport equation. (auth)

28630 MONTE CARLO GENERATION OF ELEMENTAL SENSITIVITY DATA FOR IN SITU NEUTRON CAPTURE GAMMA RAY EXPERIMENTS. Sohrabpour, M. Columbia, MO; Univ. of Missouri (1972). 121p. University Microfilms Order No. 73-21,833. Thesis (Ph. D.).

A Monte Carlo model, McCina, for prediction of detector peak count rate of in situ capture gamma ray experiment was developed. The input multigroup cross section data to the program McCina is supplied by another program XS1, developed previously, which is based on the resonance masking method of ABBN data file. The program McCina uses the product of the absorption probability estimator and the thermal-neutron-capture gamma ray data for generation of gamma rays. McCina was used to simulate an in situ experiment and favorable agreement with experimental data was obtained. A study of some of the parameters of interest in an in situ experiment such as background water concentration, source detector spacing and their effects upon the detector peak count rate was made. Sensitivity curves for ore-matrix combinations of tungsten oxide-granite and chalcocite-monzonite were produced. These curves are useful for calibration of the bore-hole probes employing Cf-252 neutron sources and Ge(Li) detectors. (Diss. Abstr.)

28631 SURVEY OF NEUTRON TRANSPORT THEORY. Kuscer, I. (Univ. of Ljubljana, Yogoslavia). Acta Phys. Austr., Suppl.; 10: 491-528(1973).

From symposium on occasion of 100th anniversary of boltzmann equation; Vienna, Austria (4 Sep 1972). See CONF-720947-.

The basic ideas of neutron transport theory are compared with those of the kinetic theory of gases, and the essential differences are indicated. Typical idealized problems are briefly described, and the mathematical and computational methods reviewed. (auth)

28632 CALCULATION OF NEUTRON PROPAGATION TAKING INTO ACCOUNT THE RESONANCE STRUCTURE OF CROSS SECTIONS. Nikolaev, M. N.; Germogenova, T. A.; Isaev, N. V.; Khokhlov, V. F. At. Energ. (USSR); 35: No. 1, 29-32(Jul 1973). (In Russian).

Results of numerical calculations of neutron propagation through a shielding slab, taking into account the resonance structure of

cross sections by the subgroup method, are described. Model examples to the $2D_N$-approximation indicate that by means of subgroup cross sections one can significantly improve the calculation accuracy of the space distribution of mean-group neutron fluxes as compared with the conventional multi-group method of calculating cross sections. Subgroup constants provide "spatial shielding" of the total neutron cross section. An example of the calculation of an iron slab by the subgroup method—and, for comparison, by the group method—is presented. (5 figures, 6 references) (auth)

28633 AVERAGING CROSS SECTIONS AND RECIPROCAL VELOCITIES TO CALCULATE THE EIGENNUMBERS OF THE NONSTEADY-STATE BOLTZMANN EQUATION. Abramov, B. D. At. Energ. (USSR); 33: No. 3, 771(Sep 1972). (In Russian).

This paper was summarized as paper No. 606/6403 with full copy held by TIC.

Several eigenfunctions and eigennumbers of the nonsteady-state Boltzmann equation are calculated for neutron transport. The multigroup method is used. The constants which should be used for a correct calculation of the various eigennumbers are determined, and the extent to which these constants differ from the usual ones are discussed. The appropriate equations are written out for averaging the cross sections and for averaging a new constant, the group-average reciprocal velocity characteristic of only the nonsteady-state theory. (JFP)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 28322, 28361, 28395, 28476, 28681, 28684, 28722, 28824, and 28932.

28634 (ITEF-896) DEPENDENCE OF THE ^{3}H BINDING ENERGY ON THE SHAPE OF THE POTENTIAL FOR N–N HARD CORE POTENTIAL. Badalyan, A. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'noi Fiziki). 1971. 11p. INIS.

The K-harmonics and Jastrow methods are combined to calculate the ^{3}H binding energy E for some Woods–Saxon type potentials with the hard core. The dependence of E on the shape of NN potentials is found to be very weak if those fit NN phase shifts up to the energy ≲400 MeV. (auth)

28635 NEW MEASUREMENTS WITH THE ^{2}H(d,p)^{3}H REACTION WITH UNPOLARIZED AND POLARIZED DEUTERONS AT LOW ENERGIES. Gueckel, F. Erlangen, Ger.; Univ. Erlangen-Nuernberg (1971). 43p. (In German).

Thesis.

The ^{2}H(d,p)^{3}H reaction has been studied anew with unpolarized and polarized deuterons in the energy range of 90–190 keV. The curve observed for the energy dependence of the coefficient B_5'/B_0 is similar to a resonance curve. This might be explained by a $J^\pi = 2^+$ level in ^{4}He slightly above the (^{2}H + d) threshold. A critical examination of available measured results of other authors has led to an unequivocal description of the energy dependence of B_5'/B_0. (16 figures) (tr-auth)

28636 MUON-CAPTURE IN DEUTERIUM IN THE ELEMENTARY PARTICLE TREATMENT. Mintz, S. L. Baltimore; Johns Hopkins Univ. (1972p. 151p. University Microfilms Order No. 73-12,157.

Thesis (Ph.D.).

The induced pseudoscalar form factor in nuclear weak leptonic processes is calculated (1) using the Nambu formulation of PCAC and (2) applying the Gell-Mann—Lévy formulation of the PCAC hypothesis directly to nuclei. Comparison of the two results with the experimental partial muon-capture rates of ^{3}He, ^{6}Li, and ^{12}C suggests that the impulse approximation estimate appears to be inconsistent with experiment in the case of ^{6}Li. Further, the total muon-capture rate in deuterium is calculated using an elementary particle treatment. The method of constructing the vector and axial-vector current matrix elements is discussed in detail. A lower limit for the total muon-capture rate is found to be $\Gamma_{tot} \geq 41.2\ sec^{-1}$, which is consistent with experimental data. By comparing the experimental values for the muon-capture rate with the theoretical capture rate expressions, information about the form factor $F_1(q^2) - F_2(q^2)$ in the time-like region is obtained. (auth)

28637 SCATTERING OF HIGH-ENERGY ELECTRONS ON THE ^{3}He NUCLEUS. Kozlovskii, I. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1097-1101(May 1973). (In Russian).

The effect of the final-state interaction of the deuterons and protons formed on the behavior of the cross section for the two-particle electron spallation of ^{3}He was examined. (3 figures) (JSR)

28638 BINDING ENERGY OF THE DEUTERON. Hare, M. G. Regina, Saskatchewan; Univ. Of Saskatchewan (1970). National Library of Canada, Ottawa.

Thesis (Ph. D.).

It was felt that by making use of the analytic properties of the graviton-particle interaction a procedure could be developed to find the binding energy of light nuclei. The goal of this work was then to do so by calculating the binding energy of the deuteron. (auth)

28639 BREAKUP OF ^{4}He NUCLEI FOLLOWING PION ABSORPTION AT REST. Barrett, R. J. Charlottesville, VA; Univ. of Virginia (1973). 119p. University Microfilms Order No. 73-18,995.

Thesis (Ph. D.).

Pion capture in ^{4}He is studied through the simultaneous measurement of the energies and relative angle of resulting neutron-charged particle pairs. Results are compatible with previous measurements of charged particle energy spectra and branching ratios. The deuteron final state exhibits a peak at the kinematic limit in the deuteron energy spectrum, in clear disagreement with existing theoretical results. It is shown that the proton final state cannot be treated with three-body kinematics. (Diss. Abstr. Int., B)

28640 NEUTRON SPECTRA FROM DEUTERON BOMBARDMENT OF D, Li, Be, AND C. Weaver, K. A. (Univ. of Wisconsin, Madison); Anderson, J. D.; Barschall, H. H.; Davis, J. C. Nucl. Sci. Eng.; 52: No. 1, 35–45(Sep 1973).

Yields and spectra of neutrons produced in the bombardment of light nuclei by deuterons of energies up to 20 MeV were measured in order to investigate the usefulness of the reactions as high intensity neutron sources. Neutrons emitted at angles up to 32 deg were studied for thin targets of deuterium and beryllium, and for thick targets of lithium, beryllium, and carbon. (auth)

28641 DISPERSION RELATION APPROACH TO n–α ELASTIC SCATTERING. Smith, R. K. College Park, MD; Univ. of Maryland (1972). 89p. University Microfilms Order No. 73-18,266.

Thesis (Ph. D.).

A dispersion relation approach to the elastic scattering of neutrons by alpha particles is presented. The relation between the bound states of the alpha particle and the phase shifts is exhibited through a dispersion relation by studying the analytic properties of the scattering amplitude. For n–α elastic scattering in the forward direction, the effects of the left hand cuts contribute significantly to the phase shifts. By dispersing on a certain combination of the spin flip and the non spin flip scattering amplitudes, the effects of these cuts can be reduced. Due to the large experimental uncertainties in the scattering amplitude in the forward direction, an accurate determination of the ^{3}He pole residue is not yet possible. On the basis of the analytic properties of the scattering amplitude, two different energy parametrizations of the phase shifts were distinguished. A further investigation of this analyticity revealed the nature of the constraints that are placed on the partial wave scattering amplitude. A potential which incorporates these effects may then be developed. (Diss. Abstr. Int., B)

28642 PHOTODISINTEGRATION OF ^{3}He. Kundu, S. K. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1972). 139p. University Microfilms Order No. 73-8124.

Thesis (Ph. D.).

Total and differential cross sections for the reaction ^{3}He(γ,d)^{1}H were measured from 13 to 45 MeV in excitation using a magnetic spectrometer and solid state detectors. A detailed and systematic study of the energy and angular dependence of the cross section of the same reaction was also carried out. The reaction was studied by electrons rather than real photons and the measured cross section is converted to the equivalent photodisintegration cross section. The target used was a cylindrical gas target of 2" diameter and 1.5" high mounted with 0.00025" Havar foil and filled with 2 atmospheres of 99.9% pure ^{3}He gas at room temperature. To date most photodisintegration experiments on the ^{3}He nucleus have been performed at one angle and/or at low energies. Existing data on the angular distributions of the process ^{3}He(γ,d)^{1}H are either statistically inaccurate with poor energy resolution or available only at few isolated energies. Moreover the total cross section inferred from the 90° differential cross section cannot be reconciled from the experimentally measured total cross section. The question of a bound excited state in the ^{3}He system is also inconclusive. The present experimental results are in good agreement with some of the previous experiments where the data overlap. Results show no inconsistency between the 90° differential cross section and the total cross section. The observed cross section, angular distribution and comparison with theory show that the final state interaction is quite important in the disintegration process. No structure in the cross section was observed within experimental uncertainties. (Diss. Abstr.)

28643 EFFECTIVE KINETIC ENERGY. II. Four-Body Forces and Their Contribution to the Binding of ^{4}He and ^{8}Be.

Nash, G. F. (North West Kent Coll. of Tech., Dartford, Eng.). Fizika (Zagreb); 5: No. 2, 61-65(May 1973).

In order to investigate the four-particle clustering tendency in α particle nuclei, an effective four-body potential taken in the form of a generalized Gaussian was added to the conventional two-body potential. The strength of this four-body potential was fitted to the binding energy of helium 4, and its contribution to the binding of beryllium 8 shown to be of the order of 5 MeV or some two percent of the total potential energy. (auth)

28644 PHOTONEUTRONS FROM ^{4}He. Malcolm, C. K. Regina, Saskatchewan; Univ. of Saskatchewan (1973). 130p. University Microfilms Order No. 73-18,663.

Thesis (Ph. D.).

Total and differential cross sections of the ^{4}He(γ,n)^{3}He reaction were measured at bremsstrahlung end point energies of 110, 100, 75, 62, and 50 MeV. The energy spectra were obtained simultaneously at five laboratory angles using neutron time of flight techniques. The total cross section agrees well throughout the energy range with available measurements of the photoproton cross section. This is expected from the dominance of E1 transitions and charge symmetry of the nuclear force. The neutron angular distribution is peaked forward of 90° at excitation energies $E_\gamma \lesssim 29$ MeV, backward for $39 \lesssim E_\gamma \lesssim 36$ MeV, and forward at higher energies. The results are compared with existing theories of the ^{4}He(γ,p)^{3}H and ^{4}He(γ,n)^{3}He reaction mechanisms, and it is suggested that both direct and resonant photon absorption are important in the low energy photoprocess. (Diss. Abstr.)

28645 BOUND STATES OF ^{4}He. Narodetski, I. M.; Galpern, E. S.; Lyakhovitski, V. N. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 46B: No. 1, 51-54(3 Sep 1973).

The energies of the bound 0^+ states of the α-particle are calculated on the basis of four body integral equations with separable $^1S_0$ and $^3S_1$ pair interactions. The ground state is found at $z_1 = -45.73$ MeV, and an excited 0^+ level is found to be -11.69 MeV. (auth)

28646 INFLUENCE OF DEUTERON WAVE FUNCTIONS ON ELASTIC PION–DEUTERON SCATTERING. Prasad, G. N. S.; Parthasarathy, R.; Devanathan, V. (Univ. of Madras). pp 41-46 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28647 FINAL-STATE INTERACTIONS IN CHARGED-PION PHOTO-PRODUCTION FROM DEUTERIUM. Srinivasa Rao, K. (Inst. of Mathematical Sciences, Madras); Parthasarathy, R.; Devanathan, V. pp 49-53 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28648 K^- ABSORPTION IN DEUTERIUM WITH FINAL-STATE INTERACTION. Sarkar, S. B.; Talukdar, B.; Chattarji, D. (Visva-Bharati Univ., Santiniketan, India). pp 61-66 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28649 NEUTRON–DEUTERON ELASTIC SCATTERING AT 128 MeV. Das Gupta, S. S. (Queen Mary Coll., London); Edgington, J. A.; Blair, I. M.; Bonner, B. E. pp 151-155 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28650 TRITON BINDING ENERGY AND n–d SCATTERING LENGTHS IN UPA USING SPIN-DEPENDENT POTENTIALS WITH HARD CORE. Maheshwari, C.; Mathur, V. S. (Banaras Hindu Univ., India). pp 157-161 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28651 CLUSTER-MODEL STUDY OF THE ^{5}He GROUND STATE. Jain, V. K.; Srivastava, B. B. (Meerut Univ., India). pp 257-261 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28652 HIGH-ENERGY ELECTRON SCATTERING FROM ^{4}He WITH CORRELATIONS. Hasan, H.; Usmani, Q. N. (Aligarh Muslim Univ., India). pp 269-274 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28653 SPIN DEPENDENCE OF THE Λ–N INTERACTION AND EXCITED STATES OF HYPERNUCLEI. Banerjee, S.; Panchapakesan, N. (Univ. of Delhi). Lett. Nuovo Cim.; 8: No. 5, 310-312(29 Sep 1973).

The 1.09 MeV and 1.42 MeV γ-rays are identified as being emitted by $^4H_\Lambda$ and $^4He_\Lambda$ respectively, which leads to the conclusion that there is significant spin dependence in the Λ–N interaction. (LBS)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 27425, 28640, 28643, 28706, 28710, 28716, 28720, 28722, 28824, 28901, 28903, 28914, 28916, 28923, 28932, 28937, and 28978.

28654 (AED-CONF-71-400, pp 177-186) ELASTIC ELECTRON SCATTERING ON GAS TARGETS, GAS TARGET PROBLEMS, AND MEASUREMENT OF THE NUCLEAR RADIUS DIFFERENCES OF ^{15}N/^{14}N, ^{18}O/^{16}O, and ^{20}Ne/^{16}O. Frank, H.; Schmidt, K. H.; Schuetz, W.; Theissen, H. (Technische Hochschule, Darmstadt, Ger.). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

For the measurement of nuclear radius differences by gas targets aluminum cells were employed. These were made by machining of aluminum pipes to a wall thickness of 200 μm. The separate cells could be combined into a threefold target (measured gas, standard gas, empty target for determination of background count rate). The special problems of gas targets are reported, e.g., the dependence of the count rate under the elastic line on the beam current. In addition, preliminary measurement results are given. The measured nuclear radius differences in the case of the N and O isotopes are smaller than is to be expected from the $A^{\frac{1}{3}}$ dependence, while for ^{20}Ne a larger radius obtains. (6 figures, 2 tables) (tr-auth)

28655 (AED-CONF-71-400, pp 359-370) PHOTONUCLEAR CROSS SECTIONS AND PAIR-PRODUCTION CROSS SECTIONS IN THE RANGE OF 10 TO 150 MeV. Ahrens, J.; Borchert, H.; Eppler, H. B.; Gimm, H.; Gundrum, H.; Riehn, P.; Sita Ram, G.; Zieger, A.; Ziegler, B. (Max-Planck Institut fuer Chemie, Mainz). 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Total-absorption cross sections for photons in Be, C, O, Al, Si, Cu, Sn, Pr, and Pb were measured for photon energies of 10 to 150 MeV. These results were used to obtain the total photonuclear cross sections in ^{9}Be, ^{12}C, ^{16}O, ^{27}Al, ^{28}Si, and ^{141}Pr and the Coulomb correction for pair-production cross sections in the field of heavy nuclei. Preliminary results are reported. (12 figures) (auth)

28656 (AERE-R-7166) NEUTRON CROSS-SECTIONS FOR ^{7}Li IN THE ENERGY RANGE 10 keV TO 15 MeV. Conlon, T. W. (Atomic Energy Research Establishment, Harwell (England)). Jul 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

The data presently available for neutron total and principal partial cross sections ($\sigma_{nn'\gamma}$ and $\sigma_{nn'\alpha t}$) in the energy range 10 to 15 MeV were reviewed, and recommended values are given. (auth)

28657 (HEDL-TME-73-49) MEASUREMENT OF ^{10}B(n,t) CROSS SECTION IN A FAST NEUTRON SPECTRUM. Lippincott, E. P.; Pitner, A. L.; Kellogg, L. S. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract AT(45-1)-2170. 19p. Dep. NTIS $4.00.

An integral measurement of the ^{10}B (n,t) 2α cross section was made in the Coupled Fast Reactivity Measurement Facility (CFRMF). The cross section was found to be 7.8 ± 0.7 mb, which is 10% below the value estimated using the ENDF/B cross section. Within errors, the ENDF/B cross section is thus indicated to give an adequate estimate of tritium production by ^{10}B in fast reactor systems. (auth)

28658 (ISN-7307) STUDY OF THE ^{6}Li(α,d_0)^{8}Be REACTION USING THE GRAPH FORMALISM. Tsan Ung Chan; Giorni, A.;

Deconninck, G. (Grenoble Univ. (France). Institut des Sciences Nucleaires). Feb 1973. 18p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The angular distributions in the $^{6}Li(\alpha,d_0)^{8}Be$ reaction are measured from 28 to 53 MeV. The graph formalism is used to interpret these results. The shape of the angular distributions is well reproduced. The main structure seems to be given by the graph with an $\alpha\alpha$ interaction near $T_0/2$ where T_0 is the kinetic energy of the incoming particle. (France)

28659 (LYCEN-7302, pp S1.1-S1.5) INTERMEDIATE COUPLING WITH PHF FUNCTIONS. Bouten, M.; Bouten, M. C.; Depuydt, H. (SCK/CEN, Mol, Belg.). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The results obtained for ^{10}B by using a PHF calculation with intermediate coupling and a calculation with intermediate coupling in the shell model are presented. The wave functions obtained in the two different calculations differ considerably. Calculations of the electromagnetic transition probabilities, which will allow the different results to be tested, are currently being developed. (FR)

28660 (LYCEN-7302, pp S4.1-S4.14) EXPERIMENTAL STUDY OF THE KNOCK-OUT OF FAST LIGHT NUCLEI (p,d,t,^{3}He,^{4}He) IN 600-MeV PROTON INTERACTIONS WITH NUCLEI; COMPARISON WITH A THERMODYNAMIC MODEL; KNOCK-OUT OF CLUSTERS. Alard, J. P. (Univ., Clermont-Ferrand, France); Baldit, A.; Brun, R.; Costilhes, J. P.; Dhermain, J.; Fargeix, J.; Frayssse, L.; Pellet, J.; Roche, G.; Tamain, J. C.; Cordaillat, A.; Pasinetti, A. 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The principle of the experiment is recalled. It is shown that the extension of the thermodynamic theory to (p;t nucleus) reactions enables a description to be obtained for the energy spectra. The probable presence of different mechanisms (knock-out of α clusters) is demonstrated together with the usefulness of quasi-free knock-out experiments with light nuclides. Results obtained from calculations on the thickness of interstellar matter traversed by cosmic radiation are presented in the framework of studies in astrophysics. (FR)

28661 (NP-19840) WEAK COUPLING CALCULATIONS FOR A = 14 AND A = 15 NUCLEI. Lie, S. (Oslo Univ. (Norway). Fysisk Institutt). 1972. 70p. Dep. NTIS (U. S. Sales Only) $5.50.

Thesis.

This theoretical study is devoted to the properties of A = 14 and A = 15 nuclei. A survey of some earlier calculations for these nuclei is given, following the development of increasingly sophisticated shell model calculations. The weak coupling model is described, and the aim of the present calculations is defined. Three papers, which have been published in Nuclear Physics, describe the results of detailed calculations in the weak coupling model for the nuclei ^{15}N and ^{15}O and also ^{14}N and ^{14}C. Further results for these nuclei are presented and compared with experimental values. A calculation for the ^{15}C nucleus is included. The weak coupling model of Ellis and Engeland has proved to be a powerful method of investigating particle–hole states in the upper p-shell nuclei. This supports the general weak coupling assumption that the coupling between particles and holes is weak compared to that of particles in the same oscillator shell. The most important feature is the over-all explanation of the individual levels up to high excitation energies for A = 14 and 15 nuclei. The simple structure of the eigenstates provides an easy interpretation of the experimental levels. (NO)

28662 ENERGY DEPENDENCE OF THE REAL CENTRAL OPTICAL POTENTIAL FOR PROTON–NUCLEUS SCATTERING. Van Oers, W. T. H.; Haw, H. (Univ. of Manitoba, Winnipeg). Phys. Lett., B; 45B: No. 3, 227-230(23 Jul 1973).

The energy dependence of the real central optical potential in the energy range 25 to 1000 MeV was determined from optical model analyses of p + ^{12}C, p + ^{16}O, p + ^{27}Al, p + ^{40}Ca and p + ^{208}Pb elastic scattering data. The volume integral and the strength can be represented by a relation linear in the incident energy only if a limited energy range is chosen. When the energy range 25 to 1000 MeV is considered a logarithmic energy dependence gives a better representation of the phenomenological results, especially for the light nuclei. (auth)

28663 PROBING THE SPIN–ORBIT COUPLING OF NUCLEAR PROTONS. Jacob, G.; Maris, T. A. J.; Schneider, C.; Teodoro, M. R. (Univ. Federal do Rio Grande do Sul, Brazil). Phys. Lett., B; 45B: No. 3, 181-183(23 Jul 1973).

The strong absorption in quasi-free scattering opens a possibility of measuring the spin-orbit coupling of nuclear protons. Cross sections for polarized incoming protons are expected to exhibit pronounced asymmetries, with size and sign depending on the selected momentum and the spin-orbit coupling in the nuclear state involved. (auth)

28664 OPTICAL MODEL STUDIES OF THE $^{13}C(\pi^+,\pi^0)^{13}N$ REACTION. Auerbach, N.; Warszawski, J. (Tel-Aviv Univ., Israel). Phys. Lett., B; 45B: No. 3, 171-174(23 Jul 1973).

The pion single-charge-exchange reaction $^{13}C(\pi^+,\pi^0)^{13}N$ is calculated using the pion-nucleus optical-model approach. The two versions of the optical potential, local and nonlocal, are investigated, and the results are compared with the recently measured cross sections in the energy range of 30 to 90 MeV. (auth)

28665 MULTISTEP CONTRIBUTIONS TO $^{11}B(h,\alpha)^{10}B$ FROM 8.0 TO 12.0 MeV. Coker, W. R. (Univ. of Texas, Austin); Lin, J.; Duggan, J. L.; Miller, P. D. Phys. Lett., B; 45B: No. 4, 321-323(6 Aug 1973).

Various improvements to the usual distorted-wave Born approximation description of direct reactions on light nuclei are investigated, using $^{11}B(h,\alpha)^{10}B$ as an example, and including finite-range effects, compound nuclear contributions, and deformation as well as inelastic process in the entrance and exit channels. It is found that only the inelastic processes and deformation play an important role, and that their inclusion, via the coupled-channel Born approximation, very satisfactorily describes the available data in shape and magnitude. (auth)

28666 CROSS SECTION OF $(\pi^+,\pi^+n + \pi^0p)$ REACTION ON ^{12}C AT THE $(3/2,3/2)$ RESONANCE. Yester, M. V.; Caretto, A. A. Jr.; Kaplan, M.; Karol, P. J.; Klobuchar, R. L. (Carnegie-Mellon Univ., Pittsburgh). Phys. Lett., B; 45B: No. 4, 327-328(6 Aug 1973).

The absolute cross section for the neutron-knockout reaction on ^{12}C with π^+ particles was measured at the $(3/2,3/2)$ pion-nucleon resonance. A value of 50 ± 4 mb was obtained. (auth)

28667 CLUSTER MODEL DWBA ANALYSIS OF LITHIUM INDUCED SINGLE NUCLEON TRANSFER REACTIONS. Kubo, K. I.; Duhm, H. H.; Ueta, N. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., B; 45B: No. 4, 299-303 (6 Aug 1973).

On the basis of the cluster model (CM) structure of the lithium isotopes the (^{7}Li,^{6}Li) reaction may be interpreted as resulting from either the n-d or n-τ cluster interaction instead of the conventionally used n-^{6}Li interaction. For the $^{12}C(^{7}Li,^{6}Li)^{13}C_{g.s.}$ transition it is shown, that the CMDWBA analysis gives quite comparable results with the recoilless HIDWBA and the "exact" finite range DWBA calculation. (auth)

28668 SOME NEUTRON ACTIVATION CROSS-SECTIONS AT 14.78 MeV. Robertson, J. C.; Audric, B.; Kolkowski, P. (National Physical Lab., Teddington, Eng.). J. Nucl. Energy; 27: No. 8, 531-541(Aug 1973).

Fast neutron activation cross sections were measured at 14.78 MeV relative to the $^{56}Fe(n,p)^{56}Mn$ cross section. The following cross sections (in millibarns) were determined: $^{14}N(n,2n)^{13}N$ 7.45 ± 0.4, $^{19}F(n,2n)^{18}F$ 47.9 ± 1.4, $^{65}Cu(n,2n)^{64}Cu$ 1043 ± 37.7, $^{160}Gd(n,2n)^{159}Gd$ 1456 ± 44, $^{198}Pt(n,2n)^{197}Pt$ 2091 ± 113, $^{27}Al(n,\alpha)^{24}Na$ 115.5 ± 3, $^{30}Si(n,\alpha)^{27}Mg$ 90 ± 11, $^{34}S(n,\alpha)^{31}Si$ 194 ± 5.9, $^{51}V(n,\alpha)^{48}Sc$ 19.5 ± 1.2, $^{59}Co(n,\alpha)^{56}Mn$ 32.3 ± 1.1, $^{24}Mg(n,p)^{24}Na$ 179.7 ± 5, $^{27}Al(n,p)^{27}Mg$ 68 ± 2.3, $^{28}Si(n,p)^{28}Al$ 265 ± 7.5, $^{29}Si(n,p)^{29}Al$ 131 ± 13.6, $^{31}P(n,p)^{31}Si$ 85.6 ± 2.6, $^{32}S(n,p)^{32}P$ 219 ± 7.1, $^{51}V(n,p)^{51}Ti$ 31 ± 1.3, $^{65}Cu(n,p)^{65}Ni$ 26 ± 1. The samples were in the form of thin foils and the activities produced after irradiation were determined using absolute $4\pi\beta$-γ coincidence counting techniques. The value of the $^{56}Fe(n,p)^{56}Mn$ cross section used as the standard was 109.8 ± 2.9 mb. The results are compared with those of others, and it is shown that by considering the ratio of individual cross sections it is possible to determine if a single cross section is grossly in error or not. (auth)

28669 APPLICATION OF THE REAL WEINBERG STATE METHOD TO UNBOUND LEVELS IN ^{13}C FORMED BY NEUTRON SCATTERING AND (d,p) ON ^{12}C. Cole, B. J.; Huby, R.; Liu, Q. K. K. (Univ. of Liverpool). J. Phys., A (London); 6: No. 8, 1224-1243(Aug 1973).

The real Weinberg state method devised to calculate a suitable form factor of the resonant final state in a stripping reaction is applied to elastic resonant scattering of neutrons by ^{12}C. The purpose is to establish the methodological accuracy of the theory. Some important adjustments to the theory are incorporated. The phase shifts of the different total angular momentum and parity ($J^\pi = 1/2^+, 3/2^+, 5/2^+$) channels are compared with the exact solution obtained from a coupled-channel method. The agreement is generally satisfactory. The parameters of the resonances yielded by the respective methods are also compared. The Weinberg method describes the levels as mixtures of discrete configurations which are either BSEC (bound states embedded in the continuum) or

single-particle resonances treated as Weinberg states. The wave functions of the respective methods are used as form factors in $^{12}C(d,p)^{13}C$ stripping calculations, again with satisfactory agreement. The role of the Weinberg method as a schematic way of solving a coupled-channel problem is briefly discussed. (auth)

28670 ALLOWANCE FOR FINAL-NUCLEUS INSTABILITY IN QUASIELASTIC KNOCKOUT OF PROTONS FROM ^{6}Li NUCLEUS. Bayukov, Yu. D.; Vorob'ev, L. S.; Kolybasov, V. M.; Leksin, G. A.; Smorodinskaya, N. Ya.; Stolin, V. L.; Fedorov, V. B. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 442-444(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 629-632(5 Jun 1973).

An explanation for the deviations from the concepts of the dominant role of the pole mechanism at small momentum transfers is found in the singularities connected with the lithium-6 nucleus. Cross sections and distributions are found. Mechanisms for the reactions (p,2p) and (π^-,π^-p) are discussed. (JFP)

28671 MUON CAPTURE RATES ON ^{16}O LEADING TO BOUND STATES OF ^{16}N. Kane, F. R.; Eckhause, M.; Miller, G. H.; Roberts, B. L.; Vislay, M. E.; Welsh, R. E. (Coll. of William and Mary, Williamsburg, VA). Phys. Lett., B; 45B: No. 3, 292-294 (23 Jul 1973).

The partial muon capture rates on ^{16}O leading to all four particle-stable states in ^{16}N were measured. The results obtained are compared to previous measurements and are also used to extract a value for the induced pseudoscalar coupling constant in muon capture. (auth)

28672 PICKUP REACTIONS OF THE (d,t) TYPE ON LIGHT NUCLEI. Zaika, N. I.; Kibkalo, Yu. V.; Mokhnach, A. V.; Nemets, O. F.; Semenov, V. S.; Tokarev, V. P.; Chesnokov, E. D.; Shmarin, P. L. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1073-1075(May 1973). (In Russian).

An experimental study was made of the j dependence of the angular distribution of tritons from (d,t) reactions on the light nuclei ^{9}Be, ^{10}B, and ^{13}C. The results showed that with decrease of the Q value the intensity of the first minimum of the angular distribution increases, independent of the value of the total transferred angular momentum, j_n. At the second minimum, in the case of $j_n = 3/2$, with decrease of the size of Q the intensity of the minimum is increased; but in the case of $j_n = 1/2$ an anomalously large intensity of the second minimum was observed. (1 figure, 1 table) (JSR)

28673 PRESSURE DEPENDENCE OF THE RADIOACTIVE DECAY CONSTANT OF BERYLLIUM-7. Hensley, W. K.; Bassett, W. A.; Huizenga, J. R. (Univ. of Rochester, NY). Science; 181: No. 4105, 1164-1165(21 Sep 1973).

Diamond anvil presses of a new design were used to compress samples of beryllium-7 oxide to 120, 210, and 270 kilobars. The decay constant for the conversion of beryllium-7 to lithium-7 by electron capture was measured for compressed and uncompressed samples. A least-squares fit of the equation $(\lambda_C - \lambda)/\lambda = K_P P$ to the experimental data, where λ_C and λ are the decay constants of the compressed sample and an uncompressed sample, respectively, and P is pressure, yields a value of $(2.2 \pm 0.1) \times 10^{-5}$ $kbar^{-1}$ for the constant K_P. (auth)

28674 BRUECKNER THEORY CALCULATION OF ^{16}O USING A VARIATIONAL APPROACH. Coon, S. A. College Park, MD; Univ. of Maryland (1972). 109p. University Microfilms Order No. 73-18,238.

Thesis (Ph. D.).

The mass operator variational principle of Brandow is demonstrated for closed-shell nuclei. The variational principle is used in a calculation of ^{16}O. The occupied states are represented by a linear combination of three major harmonic oscillator shells. The variational parameters are the mixing coefficients of the higher major shells. The G-matrix is calculated with a Pauli operator defined with respect to the single-particle wave functions. The energy spectrum of the unoccupied states is taken to be pure kinetic energy. Only skeletons that are responsible for two-body correlations via the reaction matrix are retained in this calculation. The Reid two-nucleon potential was used. The binding energy and radius are compatible with nuclear matter calculations which use the Reid potential and also include only two-body correlations. Results are compared with single major shell calculations and with other Brueckner–Hartree–Fock calculations. (Diss. Abstr. Int., B)

28675 ABSOLUTE POLARIZATION OF NEUTRONS FROM n–^{12}C SCATTERING. Holt, R. J. New Haven; Yale Univ. (1972). 129p. University Microfilms Order No. 73-14,342.

Thesis (Ph. D.).

The absolute differential polarization of neutrons elastically scattered from a spin-zero nucleus was measured, for the first time, as a continuous function of energy using a double-scattering technique. The method was applied to a study of the polarization of neutrons elastically scattered from carbon-12 at eight angles between 20 and 150° in the energy range 2 to 5 MeV. The neutron energies were determined using the nanosecond neutron time-of-flight spectrometer associated with the Yale University Electron Linear Accelerator. The primary intense flux of unpolarized neutrons was generated by the photo-disintegration of natural uranium and lead. The time-of-flight resolution was 0.75 ns. m^{-1}, corresponding to an energy resolution of 50 keV at 2 MeV. The neutron spin precession method was used to reduce systematic errors to negligible amounts. The measured differential polarizations were analyzed using a general, R-matrix reaction theory and, from this, the neutron total and differential cross sections were predicted. Good agreement with measurements of these cross sections was obtained at all energies and angles in the range 0 to 5 MeV. The predictions of the polarization of neutrons elastically scattered from carbon-12, using a deformed shell-model as a basis, were found to be in reasonable agreement with the present results. (Diss. Abstr.)

28676 REDUCED-ALPHA-WIDTH OF THE LOWEST 1^- STATE OF ^{16}O. Dyer, P. L. Pasadena, CA; California Inst. of Tech. (1973). 139p. University Microfilms Order No. 73-18,371.

Thesis (Ph. D.).

Cross sections for the reaction $^{12}C(\alpha,\gamma)^{16}O$ were measured for a range of center-of-mass alpha particle energies extending from 1.72 to 2.94 MeV. Two 8 in. × 5 in. NaI(Tl) crystals were used to detect gamma rays; time-of-flight technique was employed to suppress cosmic ray background and background due to neutrons arising mainly from the $^{13}C(\alpha,n)^{16}O$ reaction. Angular distributions were measured at center-of-mass alpha energies of 2.18, 2.42, 2.56, and 2.83 MeV. Upper limits were placed on the amount of radiation cascading through the 6.92 or 7.12-MeV states in ^{16}O. By means of theoretical fits to the measured electric dipole component of the total cross section, in which interference between the 1^- states in ^{16}O at 7.12 MeV and at 9.60 MeV is taken into account, it is possible to extract the dimensionless, reduced-alpha-width of the 7.12-MeV state in ^{16}O. A three-level R-matrix parametrization of the data yields the width $\theta^2_{\alpha,F} = 0.14^{+0.10}_{-0.06}$. A "hybrid" R-matrix-optical-model parameterization yields $\theta^2_{\alpha,F} = 0.11^{+0.11}_{-0.07}$. This quantity is of crucial importance in determining the abundance of ^{12}C and ^{16}O at the end of helium burning in stars. (Diss. Abstr.)

28677 NUCLEAR STRUCTURE OF ^{19}F. Rogers, D. W. O. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

All known data from gamma-ray spectroscopy studies of the 26 levels below 6.2 MeV excitation in ^{19}F and from 6 levels above this energy are critically reviewed, summarized and presented as tables of transition strengths. Most of the positive parity states are shown to be well described by an $(sd)^3$ shell model calculation using the Kallio-Koltveit residual interaction, and attention is drawn to levels which do not fit this description. The negative parity states outside the $K = 1/2^-$ band are shown to require more configurations in the shell model calculations than considered in weak coupling calculations. (Diss. Abstr.)

28678 PHOTOPRODUCTION OF NEGATIVE PIONS FROM ^{11}B. Janecek, P. (Tekniska Hoegskolan, Lund, Sweden). Phys. Scr.; 7: No. 4, 141-146(1973).

The $^{11}B(\gamma,\pi^-)^{11}C$ reaction was investigated theoretically using the impulse approximation and results of the theory of dispersion relations. The numerical results obtained for the total cross section are compared with the known experimental data. It is suggested that the electric dipole transition E_{0+} dominates the production. An experimental test of this suggestion is proposed. (auth)

28679 LARGE BASIS SHELL-MODEL STUDY OF NUCLEON-TRANSFER OVERLAPS. Feng, D. H.; Ibarra, R. H.; Vallieres, M. (Univ. of Manchester, Eng.). Phys. Lett.; 46B: No. 1, 37-40 (3 Sep 1973).

A new approach to two-nucleon transfer overlap calculations is presented. It is shown that the usual well-depth method underestimates the $^{16}O(t,p)^{18}O$ two-nucleon transfer form factor in the tail region by as much as 50%. (auth)

28680 MODEL-INDEPENDENT ANALYSIS OF STRIPPING TO UNBOUND LEVELS. Cole, B. J.; Huby, R. (Univ. of Liverpool). Phys. Lett.; 46B: No. 1, 55-58(3 Sep 1973).

A simple but accurate prescription is presented which may be used in the analysis of stripping to unbound levels, and which is similar to the usual DWBA approach for bound states. Its usefulness is demonstrated by a numerical example for some positive

parity resonances formed in the $^{12}C(d,p)$ reaction. The results of (d,p) and (n,n) reactions are compared. (auth)

28681 THRESHOLD PHENOMENA AND THEIR OBSERVATION. Hategan, C. (Inst. for Atomic Physics, Bucharest). Phys. Lett.; 46B: No. 1, 23-26(3 Sep 1973).

A treatment of threshold phenomena, based on S-matrix unitarity, is presented. It includes threshold cusp and types of anomalies caused by a zero energy state from the opening channel. Experimental observation of the various types of threshold phenomena and their structure is discussed. (auth)

28682 ANALYSIS OF ANGULAR CORRELATIONS IN SEQUENTIAL DECAY PROCESSES. Lang, J.; Simonius, M. (Eidgenoessiche Technische Hochschule, Zurich). Phys. Lett.; 46B: No. 1, 15-16(3 Sep 1973).

The angular distribution of particles emitted in a sequential decay reaction is discussed. It is pointed out that a recent analysis contains a hidden assumption which in general is not valid. (auth)

28683 J FORBIDDENNESS OF COMPOUND NUCLEUS MECHANISM IN THE CASE OF $^{9}Be + {}^{3}He$ REACTIONS AT LOW ENERGY. Subotic, K. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Stanojevic, D. M.; Aleksic, M. R.; Stepancic, B. Z.; Popic, R. V. Fizika (Zagreb); 5: No. 2, 103-112(May 1973).

The $^{9}Be(^{3}He,n)^{11}C$, $^{9}Be(^{3}He,n\gamma)^{11}C$, $^{9}Be(^{3}He,p\gamma)^{11}B$, and $^{9}He(^{3}Be,p)$-^{11}B reactions are studied, at 500 keV < $E_{^{3}He}$ < 1100 keV, in an attempt to obtain the additional data on 26.9 MeV level of ^{12}C. The absence of any resonant behavior at excitations corresponding to 26.9 MeV in ^{12}C system is interpreted as a case of J forbiddenness of compound nucleus mechanism, J^{π} being limited to 0^-, 3^-, and 4^- for this state. This forbiddenness inaugurates the direct mechanisms to be dominant even at low energy, as seen from the fits of experimental data. (auth)

28684 ANGULAR CORRELATION MEASUREMENTS ON THE REACTION $^{7}Li(d,n\alpha)^{4}He$. Heggie, J. C. P. Vancouver, B. C.; Univ. of British Columbia (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

An experimental investigation of the sequential process $^{7}Li(d,\alpha)$ $^{5}He \rightarrow \alpha + n$ was carried out at an energy of ~1.0 MeV. Neutron-alpha particle coincidences were measured with the neutron energy being obtained from time of flight measurements. The results are presented in the form of neutron-alpha particle angular correlations. The lifetime of ^{5}He lends support to the argument that the two stages of the reaction, the formation of ^{5}He and its subsequent decay can be treated separately. Three possible reaction mechanisms were considered for the first stage. It is expected that direct processes such as two and three particle transfer contribute very little to the yield at such a low bombarding energy. Certainly, calculations of the two-particle transfer amplitude using the formulism of DWBA are unable to fit the results. The most important reaction mechanism is shown to be compound nucleus formation through ^{9}Be. In particular, in the neighborhood of 1.0 MeV deuteron bombarding energy, the reaction proceeds largely by compound nucleus formation through the 17.28 and 17.48 MeV levels of ^{9}Be. The results suggest a spin and parity assignment of $^{5}/_{2}^{+}$ for the 17.48 MeV level and agree with a previous assignment of $^{5}/_{2}^{-}$ for the 17.28 MeV level. (Diss. Abstr.)

28685 GIANT DIPOLE STATES AND EXCITED DIPOLE STATES OF ^{12}C IN THE CONTINUUM APPROXIMATION. Pianarosa, P.; Gauvin, L. (Univ. Laval, Quebec). Lett. Nuovo Cim.; 8: No. 2, 121-122(8 Sep 1973).

Study of the giant resonance of carbon-12 suggests the breakdown of the adiabatic approximation and the presence of strong coupling between the dipole and quadrupole modes influencing the observed structure. Considering that some of the single-particle states having positive energy should be treated as scattering resonances rather than discrete levels, a generalization of a previous coupled-channel approach is developed. This involves taking into account the 2p – 2h states which are relevant to this reaction. It is expected that this approach will show a significant amount of structure in the giant dipole resonance region and perhaps reduce the overestimate of the cross section as compared to 1p – 1h models, (JFP)

28686 TOTAL AND PARTIAL MUON CAPTURE RATES ON ^{16}O LEADING TO BOUND LEVELS IN ^{16}N. Kane, F. R. Williamsburg, VA; Coll. of William and Mary (1973). 80p. University Microfilms Order No. 73-20,040.

Thesis (Ph. D.).

Negative muons produced in the muon channel at the Space Radiation Effects Laboratory (SREL) were brought to rest in an $^{16}O(H_2O)$ target. The de-excitation γ-rays emitted following muon capture to excited states in ^{16}N were observed with various solid state detectors and under different experimental conditions. Partial muon capture rates to the excited 1^- and 0^- states in ^{16}N were measured directly. The partial muon capture rate to the 2^- ground state was determined from a measurement of the total capture rate to all bound ^{16}N levels. An upper limit on the 3^- state was also determined. These measurements yielded the following capture rates: $\lambda^{1^-} = (1.31 \pm 0.10) \times 10^3$/sec, $\lambda^{0^-} = (1.56 \pm 0.17) \times 10^3$/sec, $\lambda^{2^-} = (8.02 \pm 0.64) \times 10^3$/sec, $\lambda^{3^-} < .09 \times 10^3$/sec, and $\lambda_{TOT} = (10.9 \pm 1.3) \times 10^3$/sec. These results are compared to the theoretical predictions of Fujii et al., and also to those of Donnelly and Walecka. In addition, limits on the value of the induced pseudoscalar coupling constant were obtained from a measurement of the partial muon capture rate to the 0^- state, assuming the random phase approximation as a nuclear model. (Diss. Abstr.)

28687 POLARIZATION OF $^{9}Be(p,\vec{n})^{9}B$ NEUTRONS AND THE POLARIZATION ANALYZING POWER OF CARBON IN THE NEUTRON ENERGY RANGE 2.2 TO 4.0 MeV. Sherwood, J. E. Lexington, KY; Univ. of Kentucky (1973). 49p. University Microfilms Order No. 73-20,612.

Thesis (Ph. D.).

A general description is given of fast neutron polarization and methods for producing and measuring it. The apparatus used for measuring the neutron polarization in the present investigation is described. An account is given of the procedure and results in studying the polarization of neutrons from the reaction $^{9}Be(p,\vec{n})^{9}B$ in the neutron energy range 2.2 to 4.0 MeV. It is found that the measurements of asymmetry in this study, the polarization measurements of Kelsey, and the recent work of Holt are in excellent agreement in the neutron energy range 2.2 to 3.5 MeV. Thus it is shown that ^{12}C is an effective analyzer, at least for this energy range. In the energy range $3.5 < E_n < 4.0$ MeV, the analyzing power of carbon is very small and, in fact, passes through zero except at small scattering angles. This may not be a large disadvantage since one would often prefer the small angles because of the increased scattering cross section. It is concluded also that effective polarimeters, such as the one described in this work, can be used with a variety of analyzers and, because of their simplicity and versatility, can compete favorably with helium polarimeters. (Diss. Abstr.)

28688 THEORY OF EFFECTIVE INTERACTION AND OPERATOR IN NUCLEAR STRUCTURE. Lee, S. Y. Stony Brook, NY; State Univ. of New York (1972). 180p. University Microfilms Order No. 73-21,202.

Thesis (Ph. D.).

A linked diagram expansion for the nuclear effective interaction and operator is derived. In the Green's function formalism the effective interaction is energy dependent. By the inclusion of the folded diagrams an energy independent effective interaction is derived using two different methods: The time dependent perturbation theory and the degenerate Rayleigh–Schrodinger perturbation theory. The energy independent effective interaction can be expressed in a compact and convenient form involving the energy derivatives of the irreducible vertex functions. A self-consistent spectroscopic calculation is performed for the nuclear low-lying levels of ^{18}O, ^{18}F, ^{14}N and ^{14}O using the Reid nucleon-nucleon potential. The energy dependence of the vertex function is found to be important, especially for the low-lying collective states. This is consistent with the strong renormalization effects of the folded diagrams which are found in the energy independent effective interaction. A linked diagram expansion for the effective operator is also derived. (Diss. Abstr.)

28689 SEQUENTIAL REACTION $^{15}N(^{3}He;p,\alpha)^{13}C(gs)$ AT $E_{^{3}He}$ = 11.5 MeV. Orr, M. H. University Park; Pennsylvania State Univ. (1972). 74p. University Microfilms Order No. 73-20,112.

Thesis (Ph. D.).

The reaction $^{15}N(^{3}He;p,\alpha)^{13}C(gs)$, at $E_{^{3}He}$ = 11.5 MeV, was studied using two parameter data acquisition techniques. Proton groups corresponding to at least nine possible states of ^{14}N and fifteen possible states of ^{17}O were identified. Some of the proton groups identified with ^{17}O states are probably composed of protons resulting from the formation of two or more states whose energy level spacing is smaller than the energy resolution of the experiment. Triple angular correlation data were taken with the proton detector fixed at 30° and the α-detector moved in 10° increments from 35 to 155°. Since none of the α-particle angular distributions from the decaying ^{17}O nuclei are isotropic, they are composed at least in part of α-particles resulting from the decay of states with spin $\geq^{3}/_{2}$. The 13.48 MeV state of ^{17}O, which has no previous spin assignment, is isolated from the surrounding states and was given a spin assignment of $J \geq {}^{3}/_{2}$. The majority of the ^{17}O states populated were identified with states of high spin and large Γ_α/Γ. Calculations using model dependent angular distribution functions are suggested to further test their usefulness in determining the reaction mechanism which populates the intermediate nucleus, in this case ^{17}O. (Diss. Abstr.)

28690 STUDY OF SOME ALPHA-INDUCED REACTIONS. Singh, J. (Panjab Univ., India). pp 1-6 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28691 INELASTIC PION SCATTERING BY ^{12}C. Mahalanabis, J. (Saha Inst. of Nuclear Physics, Calcutta); Banerjee, P. K. pp 35-39 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28692 MODEL DEPENDENCE OF (π^-,NN) REACTION. Jain, B. K. (Bhabha Atomic Research Centre, Trombay, India). pp 67-70 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28693 CASCADE PROCESS IN MUON CAPTURE AND NUCLEAR POLARIZATION. Devanathan, V.; Subramanian, P. R. (Univ. of Madras). pp 73-76 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28694 ELASTIC SCATTERING OF HIGH-ENERGY PROTONS ON ^{12}C AND THE α-PARTICLE MODEL. Khan, Z. A.; Ahmad, I. (Aligarh Muslim Univ., India). pp 145-150 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28695 SINGLE-PARTICLE ENERGIES AND BINDING ENERGY OF ^{16}O AND EFFECTIVE INTERACTIONS. Upadhyay, G. K.; Joshi, K. P. (Vikram Univ., Ujjain, India). pp 225-228 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28696 PROJECTED SPECTRA FROM ALPHA-CLUSTERED STATES WITH A SKYRME INTERACTION. Khadkikar, S. B. (Physical Research Lab., Navrangpura, Ahmedabad, India). pp 263-266 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28697 MEASUREMENT OF THE CROSS SECTION FOR STRIPPING AND DISSOCIATION OF DEUTERONS AT 2.7 GeV/c ON VARIOUS NUCLEAR TARGETS (A BETWEEN 9 AND 207). Bizard, G. (Univ. of Caen, France); Bonthonneau, F.; Laville, J. L.; Lefebvres, F.; Malherbe, J. C.; Regimbart, R.; Duflo, J.; Plouin, F. Nucl. Instrum. Methods; 111: No. 3, 445-449(1973).

The measurement of the cross section for stripping and dissociation of deuterons at 2.7 GeV/c on the following targets: Be, C, Al, Cu and Pb is shown. (auth)

28698 DEEP-LYING HOLE STATES IN NUCLEI BETWEEN ^{12}C AND ^{56}Fe STUDIED IN (p,d) REACTION AT 185 MeV. Fagerstroem, B.; Kaelline, J. (Uppsala Univ.). Phys. Scr.; 8: No. 1-2, 14-16(1973).

Separation energy spectra for neutron removal from ^{12}C, ^{14}N, ^{16}O, ^{24}Mg, ^{28}Si, ^{32}S, ^{40}Ca and ^{56}Fe were measured down to $E_x \approx$ 80 MeV by the (p,d) reaction at 185 MeV. Large cross sections are observed in the E_x-ranges 30 to 60 MeV of the 1p nuclei and 30 to 45 MeV of the 2s-1d nuclei. Comparison with (p,2p) results implies that these cross sections would be associated with neutron removal from the 1s and 1p shells. The present experiment indicates that the large widths reported for these states are due to contributions from several components of smaller widths. (auth)

28699 CHARGE RADII AND POLARIZATION EFFECTS IN THE OXYGEN REGION. Horsfjord, V. (Nordita, Copenhagen). Phys. Lett., 45B: No. 5, 455-458(20 Aug 1973).

When using reasonable monopole polarization charges, it is possible to fit the systematics of charge radii in the oxygen region, if core-excited components are taken into account. (auth)

28700 E1 POLARIZATION IN COULOMB EXCITATION OF ^7Li. Haeusser, O. (Atomic Energy of Canada Ltd., Chalk River, Ont.); McDonald, A. B.; Alexander, T. K.; Ferguson, A. J.; Warner, R. E. Nucl. Phys., A212: No. 3, 613-626(1973).

Coulomb excitation of the 0.478 MeV $J^\pi = 1/2^-$ state of ^7Li was studied by a particle-γ coincidence technique. From the dependence of the excitation probabilities on bombarding energy and scattering angle a sizeable interference contribution from E1 excitation of continuum states was determined. General expressions for the size of the E1 polarization effect in Coulomb excitation are given and the observed magnitudes in $^{6,7}Li$ are compared with schematic model calculations. (auth)

28701 LITHIUM ELASTIC AND INELASTIC SCATTERING AND LITHIUM-INDUCED SINGLE NUCLEON TRANSFER REACTIONS. Schumacher, P.; Ueta, N.; Duhm, H. H.; Jubo, K. I.; Klages, W. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A212: No. 3, 573-599(1973).

Absolute cross sections and angular distributions for lithium elastic and inelastic scattering as well as for lithium induced single nucleon transfer reactions were measured at 34 and 36 MeV for several p and s-d shell nuclei. The elastic and inelastic scattering data were analyzed in terms of the optical model assuming deformed targets and projectiles. Optical model potential parameters and deformation parameters were deduced. The transfer data were analyzed by finite range DWBA calculations using known spectroscopic factors. The sensitivity to the choice of potential parameter families is discussed. In some cases the best possible agreement with the transfer data was obtained by selecting the distorting potentials for incident and exit channel corresponding to a potential sum rule for the real part of the potential. The elastic and inelastic scattering data are well described by the optical model. The transfer data are also reasonably well explained, although not in all cases as satisfactorily. (auth)

28702 IN-PLANE AND OUT-OF-PLANE ANGULAR CORRELATION MEASUREMENTS FOR THE $^{12}C(n,n'\gamma)^{12}C$ REACTION AT 13.9 MeV. De Leo, R.; D'Erasmo, G.; Ferrero, F.; Pantaleo, A. (Univ., Bari, Italy). Nucl. Phys., A212: No. 2, 253-268(1973).

The angular correlations between inelastically scattered neutrons and γ-rays from the $2^+ \rightarrow 0^+$ decay of the first excited state in ^{12}C were measured. The experiment was performed with the n-detector and γ-detector placed in the reaction plane, and with the γ-detector normal to the plane. The substate excitation probabilities S_0, S_1, S_2 were determined. The results were compared with the values obtained in other experiments and with theoretical predictions. Some disagreements with the experimental data found by other authors are discussed. (auth)

28703 DYNAMICAL TREATMENT OF THE ABSORPTION IN HEAVY ION REACTIONS. Fink, B. (Univ., Frankfurt am Main); Toepffer, C. Phys. Lett., 45B: No. 5, 411-413(20 Aug 1973).

The absorption in heavy ion reactions is treated in phase space by considering the Pauli-forbidden regions for the scattering of bound nucleons. An imaginary potential is calculated without any free parameters which is surface-transparent and black in the inner region. The excitation functions for ^{12}C-^{12}C scattering can be reproduced very well. (auth)

28704 CONFIGURATION MIXING AND TOTAL MUON CAPTURE RATES. Bernabeu, J. (CERN, Geneva); Cannata, F. Phys. Lett., 45B: No. 5, 445-447(20 Aug 1973).

The Primakoff closure approximation is modified to get independence on the mean neutrino energy and energy weighted sum rules are used for the corrective terms. A near model-independent discussion is then possible, and the total rates are shown to be a very sensitive tool to investigate configuration mixing of the target. Wild discrepancies with experiment would arise if the limit of pure jj or LS couplings are used for ^{12}C, whereas the Cohen-Kurath wave function gives a very good result. (auth)

28705 FINITE RANGE DISTORTED WAVE BORN APPROXIMATION CALCULATIONS INCLUDING RECOIL FOR HEAVY ION PARTICLE TRANSFER REACTIONS. McMahan, C. A.; Toboc-man, W. (Case Western Reserve Univ., Cleveland). Nucl. Phys., A212: No. 3, 465-477(1973).

A computer code was developed to calculate the cross section for particle transfer between heavy ions using finite range DWBA including recoil. This code uses an expansion method which reduces the evaluation of a six dimensional integral to an infinite sum of products of one dimensional radial integrals. This method is found to be accurate, stable and it converges rapidly enough to be a useful calculating technique. (auth)

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Refer also to abstracts 28654, 28655, 28660, 28662, 28668, 28697, 28698, 28701, 28705, 28824, 28914, and 28937.

28706 (AED-CONF-71-400, pp 119-133) 180° ELECTRON SCATTERING EXPERIMENTS AT AMSTERDAM. Box, G.; Ellermeijer, A. L.; Lapikas, L.; van Niftrik, G. J. C.; de Vries, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam). 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

A method is described for the measurement of electron scattering through 180° from the magnetization distribution of the nucleus. This method makes use of a three-magnet system which is part of the 100-MeV electron scattering facility at the IKO in Amsterdam. So far results have been obtained for the magnetization distributions of ^{7}Li and of several $1f_{\frac{7}{2}}$-shell nuclei. A new measurement is presented of elastic scattering through 180° from ^{27}Al in the energy range of 35 to 90 MeV. From this experiment the magnetic form factor up to $q = 1$ fm^{-1} was determined with high accuracy. (auth)

28707 (COO-2186-13) INVESTIGATIONS IN RADIATIVE ALPHA CAPTURE IN ^{29}Si, ^{26}Mg, ^{31}P, ^{35}Cl, AND ^{37}Cl. Okon, O. B. II. (State Univ. of New York, Albany. Dep. of Physics). 1973. Contract AT(11-1)-2186. 235p. Dep. NTIS $13.75.

Thesis.

The (α, γ) reactions on silicon-29 and magnesium-26 were studied. Resonances, angular distributions, and spins and parities for energy levels of silicon-33, -30 are discussed. Also excitation functions for alpha capture on phosphorus-31, chlorine-35 and -37 are found. The energy range was studied for 2 to 4.2 MeV. (JFP)

28708 (ITEF-911) MEASUREMENT OF T-NONINVARIANT ANGULAR CORRELATION IN REACTION ^{35}Cl(n,γ)^{36}Cl ON POLARIZED SLOW NEUTRONS. Bulgakov, M. I.; Gulko, A. D.; Danilyan, G. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'noi Fiziki). 1972. 8p. INIS.

In connection with CP violation in K_2^0-meson two pions decay T-noninvariant angular correlation of two γ-quanta of the cascade 7.79 to 0.79 MeV accompanying the polarized slow neutron capture by the ^{35}Cl nucleus was measured. The measured asymmetry was found to be $(-0.5 \pm 1.5) \cdot 10^{-4}$ hence for the relative phase of reduced matrix elements in mixed electromagnetic transition of the ^{36}Cl nucleus the value $\eta = (-0.9 \pm 2.9) \cdot 10^{-3}$ was obtained. (auth)

28709 (LYCEN-7302, pp S18.1-S18.11) WAVE FUNCTIONS OF THE SHELL MODEL FOR 4n NUCLEI IN THE sd SHELL. Study of ^{24}Mg in the Complete 8-Particle Configuration Space in the sd Shell. Soyeur, M. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The variations of the energy spectra, the electromagnetic properties, and the wave functions were studied for the ^{28}Si nucleus for the case when the dimension of the configuration space inside the sd shell is increased. A study was then undertaken of ^{24}Mg in the complete configuration space of 8-nucleon states in the sd shell. (FR)

28710 EVIDENCE FOR BOSON-MODE EXCITATIONS IN THE ^{16}O(α,n) AND ^{20}Ne(α,n) EXCITATION FUNCTIONS. Gruhle, W. (Univ., Cologne); Bauer, T.; Seligmann, T. H.; Hackenbroich, H. H. Z. Phys.; 262: No. 3, 271-278(1973).

Excitation functions for ^{16}O(α,n) and ^{20}Ne(α,n) have been measured from threshold to 26 and 31 MeV compound excitation energy, respectively. The dominating compound states are interpreted as boson excitation modes of nuclei with α-particle structure. (4 figures, 1 table) (auth)

28711 B(E2) VALUE OF THE FIRST EXCITED STATE OF ^{26}Mg. Lees, E. W.; Johnston, A.; Brain, S. W.; Curran, C. S.; Gillespie, W. A.; Singhal, R. P. (Univ. of Glasgow). J. Phys., A (London); 6: No. 8, L116-L120(Aug 1973).

The first excited state of ^{26}Mg was studied by inelastic electron scattering in the momentum transfer range 0.4 to 1.05 fm^{-1}. The reduced transition probability and transition radius were measured to be 275 ± 20 fm^4 and 4.13 ± 0.06 fm respectively. The reduced transition probability was found to be more accurate and of slightly smaller magnitude than existing experimental results. A Nilsson model form factor calculation was found to provide reasonable agreement with the experimental data. (auth)

28712 STUDY OF ELASTIC SCATTERING OF PROTONS BY THE NUCLEI ^{28}Si AND ^{32}S. Gubin, V. B.; Gulamov, I. R.; Romanovskii, E. A.; Spasskaya, T. I.; Sirotinin, E. I.; Shishkin, K. S. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1083-1087(May 1973). (In Russian).

The energy and angular dependence of the cross section for elastic scattering by ^{28}Si and ^{32}S were measured by using the thick-target method. The excitation functions for the elastic scattering of protons by ^{28}Si were determined for $\theta_{lab} = 40$, 90, 120, and 160° in the energy interval from 5.5 to 6.2 MeV. The angular distribution curve for the elastic scattering at an energy of 5.93 MeV is shown. The energy dependence of the cross section for the elastic scattering of protons by ^{32}S was shown. The angular distribution of protons for different energies was determined. (4 figures) (JSR)

28713 INVESTIGATION OF (d,p) REACTIONS UNDER CONDITIONS TRANSITIONAL FROM ABOVE THE BARRIER TO COULOMB STRIPPING. Part I. ^{27}Al(d,p)^{28}Al and ^{32}S(d,p)^{33}S Reactions. Orlova, T. V.; Litvin, V. F.; Nemilov, Yu. A.; Zherebtsova, K. I.; Lakomkin, Yu. A.; Supardzho Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1059-1067(May 1973). (In Russian).

An investigation of the reactions ^{27}Al(d,p)^{28}Al and ^{32}S(d,p)^{33}S under conditions transitional from above the barrier to Coulomb collapse showed, at energies above the barrier in the entrance channel, the possibility of a precise spectroscopic study of those levels of the final nucleus for which the above-the-barrier energy in the entrance channel of the reaction is responsible. Values of l_n and (2I + 1)S were found for 19 levels of ^{28}Al and ^{33}S. Indications were obtained on the possibility of preferential excitation of 0^+ states of even–even cores during formation of some levels of the final nucleus. (6 figures, 2 tables) (JSR)

28714 ^{24}Mg(α,d)^{26}Al REACTION AT 25 AND 50 MeV. Oliver, D. W. Tallahassee, FL; Florida State Univ. (1972). 108p. University Microfilms Order No. 73-21,352.

Thesis (Ph. D.).

The ^{24}Mg(α,d)^{26}Al reaction was studied at energies $E_\alpha = 24.0$ to 25.5 and $E_\alpha = 50$ MeV. Excitation functions and angular distributions were obtained from 24.0 to 25.5 MeV for the first three T = 0 levels in ^{26}Al, and angular distributions for all the T = 0 states with $E_x \leq 3.074$ MeV were taken at 50 MeV. Nondirect structure was seen in the excitation functions of the low energy data, and DWBA calculations were not successful in reproducing the changes in shape with energy of the observed angular distributions. DWBA calculations were also made for the 50 MeV data, and were largely successful in fitting the observed angular distributions. Spins and parities were assigned to ^{26}Al levels based on the determination of the L transfers, and in all cases agreed with previous results. (Diss. Abstr.)

28715 NEW PARTIAL WAVE STUDIES OF DIRECT REACTIONS: AN EXPERIMENT WITH (d,n) STRIPPING. Murphy, B. D. Charlottesville, VA; Univ. of Virginia (1973). 135p. University Microfilms Order No. 73-18,979.

Thesis (Ph. D.).

Using three different (d,n) stripping cases a partial wave study of direct reactions as a function of Q-value was performed. The three strippings involved pure l = 0 transfers in the reaction ^{22}Ne(d,n)^{23}Na. The Q-values are 4.18, 0.26, and −2.09 MeV. Angular distributions with good relative accuracy were obtained with data points at three degree intervals in the zero to 90 deg region and at six degree intervals from 90 to 138 deg. Using Fourier transform techniques much of the statistical noise was removed from the data before proceeding with the analysis. Legendre polynomial fits up to order 14 were obtained for the three angular distributions. A parameter searching procedure was used to find partial wave distributions corresponding with these polynomial fits. In view of the existence of multiple solutions in problems of this nature, theoretically calculated partial wave distributions were used as a starting approximation and some physical conditions were imposed in searching for the experimental solutions. The outgoing neutron partial wave fluxes are presented as are the associated S-matrix elements. The flux contributions due to compound nucleus effects are estimated. This compound nuclear flux is subtracted from the experimentally determined flux. The localization in l-space of the flux due to direct reaction processes is discussed. (Diss. Abstr.)

28716 NUCLEAR STRUCTURE IN THE CONTINUUM–MAGNESIUM-24. Wieland, R. M. New Haven; Yale Univ. (1973). 409p. University Microfilms Order No. 73-19,045.

Thesis (Ph. D.).

The ^{24}Mg nuclear system was studied by two approaches: the measurement of the elastic and inelastic scattering in the ^{12}C + ^{12}C interaction, and an investigation of the three-body final state channels in the ^{16}O + ^{12}C interaction, proceeding primarily through intermediate states in ^{24}Mg. These measurements were undertaken in order to search for the presence of heavy cluster quasimolecular configurations as evidenced either indirectly in the resonance coupling between elastic and inelastic ^{12}C channels or directly through the observation of well defined states in ^{24}Mg populated in the ^{12}C(^{16}O,α)^{24}Mg reaction with large relative widths for decay into the ^{12}C–^{12}C channel. The elastic and inelastic (single and mutual excitation of the 4.43 MeV level) channels in ^{12}C + ^{12}C scattering

were measured at E_{cm} = 20 to 30 MeV over θ_{lab} = 15.5 to 50.5° in steps of 250 keV and 1°, respectively. The cross sections for the inelastic excitations were found to be comparable to those for the elastic channel in absolute value. Comparisons are presented between the predictions of coupled channel reaction models and the data. The study of the reaction $^{12}C(^{16}O,\alpha_1)^{24}Mg(\alpha_2)^{20}Ne$ has resulted in a determination of spins and parities of a number of narrow-width states in ^{24}Mg at excited energies near 16 MeV. Further studies were performed on the three-body final states associated with this reaction. No evidence was found for the existence of quasimolecular states in the excitation energy region ($E_x \geq 21$ MeV) in ^{24}Mg. The gross features of the channels observed are found to be consistent with the statistical theory for compound nuclear reactions. This excludes consideration of a strong direct $\alpha-^{12}C$ correlation observed in the $^{12}C-^{12}C-\alpha$ channel. Finally, general arguments based on energy and angular momentum conservation principles are advanced to qualitatively explain many of the features observed in these reactions in terms of the large angular momentum characteristic of the compound systems formed and the resultant decrease in the number of open channels for decay. (Diss. Abstr.)

28717 TREATMENT OF PAIRING AND THE CHARGE INDEPENDENT PAIRING CORRELATIONS IN NUCLEI. Ghosh, M. K. Eugene, OR; Univ. of Oregon (1973). 102p. University Microfilms Order No. 73-20,208.

Thesis (Ph. D.).

The modified Tamm Dancoff approximation (MTDA) for pairing vibrations is studied. The method is found to be useful for the treatment of pairing correlations in deformed nuclei. The numerical calculations are presented for ^{24}Mg which test the accuracy of the MTDA in deformed nuclei. The RPA extension of the method (MRPA) is carried out and used to calculate pairing correlations in the ground and the excited states of Pb-isotopes. With a proper treatment of the correlations correction both in the one phonon and the two phonon state, significant improvement was found in predicting theoretically the ratio of the two nucleon transfer matrix element populating the ground state of ^{208}Pb and the excited two phonon pair vibrational state of ^{208}Pb. An algebraic treatment of pairing Hamiltonian is given based on quasispin group algebra. The success of the MTDA is shown to be connected with the fact that seniority is a fairly good quantum number for nuclear ground states. In the degenerate model, an algebraic treatment of the charge independent pairing ($T = 1$) Hamiltonian is given based on the generalized quasispin group. It is shown that the treatment gives exact ground state energy. A new derivation of the pairing and the generalized pairing theories for nuclei is given based on a self-consistent orthonormalization procedure within the context of the equation of motion method. For the nondegenerate case, a new treatment of charge independent pairing Hamiltonian is developed. The $T(T + 1)$ dependence in the nuclear ground state energy is incorporated in the BCS theory through the "energy equation" based on the generalized quasispin group algebra. The unambiguous extension of the BCS theory to the more general case in isospin coupled representation is obtained through a self-consistent orthonormalization procedure. The prescription for minimizing fluctuation due to the number and isospin nonconservation is given. The simplified case of $N = Z$ nuclei is discussed. Numerical calculations are presented for ^{60}Zn and some new aspects are studied in the more general case of $N \neq Z$ nuclei. (Diss. Abstr.)

28718 $^{20}Ne(\alpha,\alpha_{0,1,2})^{20}Ne$ EXPERIMENT AT 16.8 MeV WITH AUTOMATED DATA ANALYSIS. Frickey, J. W. Tallahassee, FL; Florida State Univ (1972). 138p. University Microfilms Order No. 73-21-346.

Thesis (Ph. D.).

Energy-averaged angular distributions were measured at 16.8 MeV for scattering to the ground state and first two excited states of ^{20}Ne. Direct and compound-nuclear contributions were estimated. Optical-model fits to the elastic scattering data with three discrete real potentials (V = 34, 57, and 83 MeV) were greatly improved by an l-dependent absorption. Only two well depths (50 and 80 MeV) gave reasonable 0^+-2^+ coupled-equation fits. Slightly better results for $0^+-2^+-4^+$ coupling were obtained by including a j-dependent absorption with V = 50 MeV, W = 4.0 MeV, R = 4.94, $F,\beta_2 = 0.40$, and $\beta_4 = 0.0$. A procedure which provides for totally automatic data handling from data acquisition to finished display was developed for this experiment. This procedure utilizes an integrated system of software packages written in assembly language for the EMR 6130 on-line computer and in FORTRAN for the CDC 6400. Data acquisition, data reduction, and data analysis subsystems are included. (Diss. Abstr.)

28719 PROPERTIES OF STATES IN ^{33}S. Balakrishanan, M.; Mehta, M. K.; Kailas, S.; Kanetkar, L. J.; Divatia, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 9-14 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See Conf-721231-.

28720 NON-PERTURBATIVE CALCULATION OF K^- ABSORPTION IN NUCLEI. Chattarji, D.; Ghosh, P. (Visva-Bharati Univ., Santiniketan, India). pp 55-60 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28721 ANALYSIS OF THE ^{28}Si ELASTIC SCATTERING FROM ^{28}Si. Saini, S.; Mehta, M. K. (Bhabha Atomic Research Centre, Trombay, India). pp 131 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28722 VALIDITY OF HARTREE–FOCK APPROXIMATION IN LIGHT SPHERICAL NUCLEI. Satyan, V.; Parikh, J. C. (Physical Research Lab., Ahmedabad, India). pp 289-292 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28723 MAGNETIC MOMENTS OF THE A = 21 MIRROR NUCLEI. Gunye, M. R. (Tata Inst. of Fundamental Research, Bombay). pp 311-315 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28724 PAIRING IN d–s SHELL. Parikh, J. (Atomic Minerals Div., New Delhi); Pandya, S. P. pp 317-320 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28725 IMPROVED HARTREE–FOCK CALCULATIONS FOR ^{28}Si. Kulkarni, D. R.; Pandya, S. P. (Physical Research Lab., Ahmedabad, India). pp 335-338 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28726 GAMMA-DECAY OF THE LOWEST T = 2 STATE OF ^{24}Mg. Szuecs, J.; Underwood, B. Y.; Alexander, T. K.; Anyas Weiss, N. (Nuclear Physics Lab., Oxford). Nucl. Phys., A212: No. 2, 293-303(1973).

The lowest T = 2 level of ^{24}Mg was observed as a resonance in the γ-ray yield from the $^{23}Na(p,\gamma)^{24}Mg$ reaction at E_p = 3905 ± 3 keV. Gamma-ray branching ratios for this $J^\pi = 0^+$, T = 2 level at 15434 ± 3 keV to the $J^\pi = 1^+$, T = 1 states at 9967 ± 2 keV and 10711 ± 2 keV were measured to be (83 ± 2)% and (17 ± 2)%, respectively. The branching ratios for the decay of the T = 1 levels were also determined. The resonance strength was found to be $\omega\gamma = 1.9 \pm 0.5$ eV. The M1 transition probabilities deduced are $\Gamma_\gamma(M1) = 0.8 \pm 0.3$ Weisskopf units (W.u.) for the 15434 → 9967 keV transition and $\Gamma_\gamma(M1) = 0.27 \pm 0.09$ W.u. for the 15434 → 10711 keV transition. A comparison is made between the $\Gamma_\gamma(M1)$ values deduced from the present experiment and the values calculated from the data on the analog β-decay of ^{24}Ne. (auth)

28727 KUO INTERACTION AND BAND SHIFTS IN THE SD-SHELL. Cole, B. J.; Watt, A.; Whitehead, R. R. (Univ. of Glasgow). Phys. Lett., 45B: No. 5, 429-432(20 Aug 1973).

Evidence is presented to show that the major defect of the Kuo interaction in untruncated shell-model calculations in the sd-shell that it produces shifts of whole rotational bands relative to one another, the calculated spacings within the bands being well reproduced even where they do not follow the J(J + 1) rule. The results of calculations in ^{23}Na, ^{24}Na, ^{26}Al and ^{33}P are used as illustrations. (auth)

28728 SCATTERING OF POLARIZED PROTONS FROM Si IN THE GIANT RESONANCE REGION OF ^{29}P. Lamontage, C. R. (Univ., Laval, Quebec); Frois, B.; Slobodrian, R. J.; Conzett, H. E.; Leemann, C.; De Swiniarski, R. Phys. Lett., 45B: No. 5, 465-468(20 Aug 1973).

A simultaneous measurement was made of analyzing powers and cross sections of protons scattered elastically from Si between 17 and 29 MeV. An optical model analysis shows anomalous nonmonotonic behavior of the spin orbit potential in this energy region. (auth)

28729 PRODUCTION OF NEUTRONS IN Pb, Cd, Fe, AND Al BY HIGH ENERGY MUONS. Gorshkov, G. V.; Zyabkin, V. A.; Yakovlev, R. M. Yadern. Fiz.; 18: No. 1, 109-117(Jul 1973). (In Russian).

Measured results are presented on production of neutrons in Pb, Cd, Fe induced by the hard charged component of cosmic radiation at the surface. Energy dependence of the averaged product of the interaction cross section and the neutron multiplicity induced by high-energy muons is calculated for Pb, Cd, Fe and Al using the theory of electromagnetic muon interactions. Direct muon interaction processes, the δ-electron production, the muon brehmsstrahlung and the direct pair production by muons are taken into account. Averaging over the muon spectra at various depths under ground the depth dependences of the mentioned processes are obtained. The experimental data of the present work, as well as results obtained previously, are compared with the calculated dependences. It is shown that for depths up to 800 m water equivalent the neutron production by high energy muons may be explained as a result of electromagnetic interactions of muons. (auth)

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Refer also to abstracts 28660, 28662, 28668, 28698, 28720, 28722, 28729, 28730, 28780, 28816, 28820, 28901, 28904, 28924, 28959, and 28962.

28730 (AED-CONF-71-400, pp 371-380) MEASUREMENTS OF PARTIAL CROSS SECTIONS OF PHOTONUCLEAR REACTIONS LEADING TO DIFFERENT STATES OF RESIDUAL NUCLEI. Brajnik, D.; Jamnik, D.; Kernel, G.; Miklavzic, U.; Stanovnik, A.; Tiringer, M. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Apparatus for measuring spectra of deexcitation γ rays from reactions $(\gamma,p\gamma')$ and $(\gamma,n\gamma')$ as well as spectra of photoprotons is described. The cross sections to different states of residual nucleus were obtained from the yields of the deexcitation γ rays and from the spectra of photoprotons measured at different endpoint energies of the betatron bremsstrahlung spectrum. The results for the partial photonuclear reactions in ^{40}Ca and ^{90}Zr are presented and compared with theoretical calculations. (6 figures) (auth)

28731 (LYCEN-7302, pp S16.1-S16.16) HEAVY ION INDUCED TRANSFER REACTIONS AS A SPECTROSCOPIC TOOL. Mermaz, M. C. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

Typical examples of transfer reactions of two and 4 nucleons induced by heavy ions in the 1f−2p shell are cited. The mechanisms of these types of reactions near to the Coulomb barrier were studied for the case of projectiles having much smaller masses than the target; phase-shift analysis of the elastic angular distributions, calculation of quasi-elastic transfer cross sections (Frahn and Venter model), and DWBA analysis are included. The effect of the choice of optical potential on the cross sections, the dependence of the cross sections on the reaction energy Q, and the effect of configuration mixing on the cross sections were analyzed using the results of DWBA calculations effected with the SETILL code. (FR)

28732 (LYCEN-7302, pp S19.1-S19.6) IMPORTANCE OF THE ASYMPTOTIC PART OF THE OPTICAL POTENTIAL IN ^{52}Cr (t,t$_0$) ^{52}Cr BETWEEN 2 AND 3.5 MeV. Bonneaud, G.; Senger, B.; Bing, O.; Magnac-Valette, D. (CNRS, Strasbourg). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

It is shown that, in the case of the elastic scattering of tritons in the sub-Coulomb region of ^{52}Cr, the optical model provides a description which is sensitive only with respect to the choice of optical potential in the asymptotic region, and has an uncertainty corresponding to experimental errors. (FR)

28733 (OULNS-73-2) ANNUAL REPORT OF LABORATORY OF NUCLEAR STUDIES, OSAKA UNIVERSITY, JANUARY 1972 − DECEMBER 1972. (Osaka Univ. (Japan). Lab. of Nuclear Studies). [nd]. 103p. NTIS (U.S. Sales Only).

The annual report of Laboratory for Nuclear Study, Osaka University is presented. Differential cross sections of the (α,t) reactions ^{50}Ti and ^{56}Fe were measured for elucidating the (α,t) reaction mechanism and a two-step reaction mechanism via inelastic channels was suggested as a possible explanation of the observation. Levels of ^{56}Co and ^{58}Co up to about 3 MeV excitation were investigated by the direct ^{54}Fe$(\alpha,d)^{56}$Co and ^{56}Fe$(\alpha,d)^{58}$Co reactions with 23.9 MeV alphas. Charge exchange giant resonances were studied from a view point of the isospin (spin) core polarization. Effective M2 and E3 transition moments in the single particle M2 and E3 transitions in ^{141}Pr were measured by exciting the 1h11/2$^-$ state by means of the ^{139}La$(\alpha,2n\gamma)$ reaction at Eα = 22 to 24 MeV and the magnetic moment of the 1h11/2$^-$ state in ^{141}Pr was investigated at the same time. Spin alignment in the $(\alpha,2n\gamma)$ reaction was studied for the ground band levels of ^{144}Nd, ^{148}Sm, ^{150}Sm, and ^{152}Sm and the analysis of the results was completed. Electromagnetic properties of the low-lying levels of ^{143}Pm were studied by measuring γ rays following the ^{141}Pr$(\alpha,2n)^{143}$Pm reaction. Angular distribution coefficients for the ^{95}Tc states were measured by means of the ^{93}Nb$(\alpha,2n\gamma)^{95}$Tc reaction. The lifetimes of the excited states in ^{90}Zr were measured by the Doppler shift attenuation method using the ^{88}Sr$(\alpha,2n)^{90}$Zr reaction. Charged particle detectors were prepared from germanium crystal with the high purity. Several other works were undertaken as well on such topics as the NMR spectra of the short-lived β emitter ^{8}B, the magnetic moment of the β-emitter ^{41}Sc, sign determination of eqQ for ^{12}B implanted in Ta and so on. (H. Baba)

28734 PARTIAL WAVE ANALYSIS OF ELASTIC AND INELASTIC SCATTERING OF DIRAC PARTICLES. Mercer, R. L. Urbana, IL; Univ. of Illinois (1972). 159p. University Microfilms Order No. 73-17,327.

Thesis (Ph.D.).

The problem of elastic and inelastic scattering of particles from a quantum mechanical center of force has been analyzed theoretically and computationally. Programs have been written in which effects due to excited states are treated correctly. NADIR handles the case of Coulomb monopole elastic and inelastic scattering with spin zero targets. ZENITH handles the general problem. A number of checks of the programs are described. The programs are then applied to estimate the dispersion corrections in elastic scattering of electrons from isotopes of calcium, and to investigate the effect of Coulomb distortion in magnetic scattering at 180°. (auth)

28735 SPECTRUM OF γ RADIATION ARISING DURING THE DECAY ^{44}Ti → ^{44}Sc → ^{44}Ca. Grigor'ev, E. P.; Aleksandrov, A. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 989-992(May 1973). (In Russian).

The decay chain was investigated by using a γ spectrometer with Ge(Li) detectors 0.5, 10, 27, and 37 cm^3 in volume. The energy and intensity of the γ emission were measured and compared with the results obtained by previous investigators. A decay scheme for the chain decay is proposed. (1 figure, 2 tables) (JSR)

28736 INVESTIGATION OF (d,p) REACTIONS UNDER CONDITIONS TRANSITIONAL FROM ABOVE THE BARRIER TO COULOMB STRIPPING. Part II. ^{50}Cr(d,p)^{51}Cr Reaction. Orlova, T. V.; Litvin, V. F.; Nemilov, Yu. A.; Zherebtsova, K. I.; Lakomkin, Yu. A.; Bochin, V. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1068-1072(May 1973). (In Russian).

The reaction ^{50}Cr(d,p)^{51}Cr was investigated under conditions transitional from above the barrier to Coulomb stripping. It was shown that at above the barrier energy in the entrance channel of the reaction a precise spectroscopic investigation of the levels of the final nucleus is possible, in the sense of the determination of l_n for $l_n \leq 3$. Five of the low-lying levels of the excited nucleus ^{51}Cr fit well into the weak-coupling scheme with the configuration $[(2^+)nf_{\frac{7}{2}}]^J$. The observed anomalously intense excitation of one of the members of this multiplet under these conditions can be ascribed to a cascade mechanism of stripping. (4 figures, 2 tables) (JSR)

28737 NUCLEAR SPECTROSCOPY OF ^{42}Ca AND ^{48}Ti NUCLEI AND THE APPLICATION OF NEWSR METHODS OF ANALYSIS. Jamshidi, A. Rochester, NY; Univ. of Rochester (1973). 162p. University Microfilms Order No. 73-14,815.

Thesis (Ph. D.).

The ^{41}K(^{3}He,d), ^{43}Ca(d,t) and ^{49}Ti(d,t) measurements were carried out at incident energies of 23, 20, and 18 MeV, respectively and with energy resolution of 9 to 14 keV (FWHM). Single-particle strength distributions were studied up to an excitation energy of 6.24 MeV in ^{42}Ca and 7.04 MeV in ^{48}Ti. The fragmentation of the strengths of the l = 2 pickup and l = 3 stripping transitions, to the negative parity states in ^{42}Ca, were measured to be severe. The extent of the l = 0 and l = 2 admixtures is seen to be small in the ^{49}Ti(d,t) reaction, in contrast to the large admixtures observed in the ^{43}Ca(d,t) work. The l = 3 ($1f_{\frac{7}{2}}$) pickup strength is observed to be fragmented more severely in the ^{43}Ca(d,t) reaction than the ^{49}Ti(d,t) case. The admixture of the $1f_{\frac{7}{2}}$ and 2p (presumably $2p_{\frac{3}{2}}$) configurations in the ^{43}Ca and ^{49}Ti g.s. wave functions is measured

to be small. High resolution (α,α') measurements were performed at incident energy of 28.5 MeV, using enriched isotopes of ^{42}Ca and ^{48}Ti as targets. As a result of these experiments, spin-parities were assigned to a number of excited states in ^{42}Ca and ^{48}Ti. Non-energy weighted sum rule (NEWSR) methods were applied to the results of the present and previous studies in order to obtain the strength of the $(1d_{\frac{3}{2}})^2_{0^+}$ core-excited components in the ground state wave functions of the ^{41}K, ^{43}Ca, ^{45}Sc, ^{49}Ti, and ^{51}V targets. With spin suggestions for some of the residual excited states, the strength of such core-excited components is found to be less than 5% for the ^{51}V and 10% for the ^{43}Ca and ^{49}Ti targets. A single g.s. wave function for the ^{41}K, with no core-excited components, gives good agreement with experimental observations. Only a tentative measure of the core-excitation could be obtained for the ^{45}Sc target, because of the ambiguities in the existing experimental results. (Diss. Abstr.)

28738 INVESTIGATION OF LOW-LYING EXCITED STATES IN SOME VANADIUM ISOTOPES. Rickel, D. G. Tucson, AZ; Univ. of Arizona (1973). 147p. University Microfilms Order No. 73-20,648.

Thesis (Ph. D.).

Energy level studies of the nuclei ^{47}V, ^{49}V, and ^{50}V were made. The mode of excitation was through p,n reactions on the appropriate titanium targets. All information was extracted by the analysis of the γ ray emissions from the de-exciting vanadium nuclei. Vanadium 47 was excited up to 1.6 MeV in which range was located 7 excited energy levels. There were 16 levels located up to an excitation energy of 2.4 MeV for vanadium 49, while vanadium 50 had 13 levels in the first 1.7 MeV of excitation. Branching ratios were measured for those states having more than one mode of γ decay. Tentative spin and parity assignments were given to all the energy levels identified. These assignments were based partly on the γ ray decay characteristics and on previous angular distribution studies of the levels. Those levels that closely resemble $(f^1_{\frac{7}{2}})^n$ shell mode states were tentatively given that identification. There are several levels with positive parity in ^{47}V and ^{49}V that were found to have rotational character. These studies in ^{47}V are the 262, 660, and 1139 keV levels with assignments of $^3/_2{}^+$, $^5/_2{}^+$ and $^7/_2{}^+$ respectively. The levels in ^{49}V are the 748, 1139 and 1602 keV levels with assignments of $^3/_2{}^+$, $^5/_2{}^+$ and $^7/_2{}^+$. If the nuclei are presumed deformed while in these states the moments of inertia are 77 keV for ^{47}V and 66 keV for ^{49}V. Mean lives were measured for 6 states in ^{50}V by the doppler shift attenuation method. These mean lives are: τ(910 keV) $< 10^{-13}$ sec, τ(1301 keV) $< 6 \times 10^{-14}$ sec, τ(1331 keV) $< 1 \times 10^{-14}$ sec, τ(1493 keV) $< 2 \times 10^{-14}$ sec, τ(1517 keV) $8 \times 10^{-14} < \tau < 1.2 \times 10^{-13}$, and τ(1560 keV) $6 \times 10^{-14} < \tau < 10^{-11}$. The transition rates for those states identified as $(f^1_{\frac{7}{2}})^n$ configurations were calculated using the McCullen, Bayman and Zamick (MBZ) wave functions. A comparison of these values to the measured branching ratios and mean lives was made. (Diss. Abstr.)

28739 SEARCH FOR BRANCHING IN THE BETA DECAY OF ^{42}Sc. Kennedy, H. J. Tucson, AZ; Univ. of Arizona (1973). 105p. University Microfilms Order No. 73-20,657.

Thesis (Ph. D.).

Beta decay of the ground state of ^{42}Sc is studied experimentally. It is shown that branching to the first excited 0^+ state of ^{42}Ca is related to the purity of the isospin triplet formed by ^{42}Ca, ^{42}Sc and ^{42}Ti. The ^{42}Sc nuclei are formed by bombarding ^{39}K nuclei with alpha particles at 8.7 MeV, thereby inducing the reaction ^{39}K(^{4}He, n)^{42}Sc. Subsequent appearance of beta decay to the excited 0^+ level of ^{42}Ca is sought by looking for the 1524-keV gamma ray which would occur following such a decay. Coincidence and singles techniques of measurement are described and a singles experiment is performed which gives an upper bound to the branching ratio of $R = 4.4 \times 10^{-4}$ with 95% confidence, a value well within theoretical expectations. (Diss. Abstr.)

28740 (p,n) REACTION CROSS-SECTION MEASUREMENTS ON ^{50}Ti, ^{54}Cr, and ^{59}Co. Chintalapudi, S. N.; Kailas, S.; Ganguly, N. K.; Gupta, S. K.; Kenetkar, L. J.; Kerekatte, S. S.; Mehta, M. K. (Bhabha Atomic Research Centre, Trombay, India). pp 17-22 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28741 CAPTURE AND ELASTIC SCATTERING OF PROTONS BY ^{51}V. Iyengar, K. V. K.; Roy, A.; Jhingan, M. L.; Bhattacherjee, S. K.; Raheja, U. T. (Tata Inst. of Fundamental Research, Bombay). pp 23-29 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28742 ^{58}Ni REACTION CROSS SECTIONS FOR 14-MeV NEUTRONS USING OPTICAL MODEL POTENTIAL. Wadhwa, B. S.; Mohindra, R. K. (Kurukshetra Univ., India). pp 139-143 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28743 MIXED-CONFIGURATION SHELL-MODEL WAVE FUNCTIONS AND ENERGIES OF ^{51}V. Rao, G. R.; Subudhi, K. S. (Birla Inst. of Tech. and Science, Pilani, India). pp 233-234 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28744 SU(4) SYMMETRY EXHIBITED BY ODD–ODD NUCLEI IN $1f_{\frac{7}{2}}$ SHELL. Gupta, S. K. (Bhabha Atomic Research Centre, Trombay, India). pp 251-254 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28745 INSTABILITY OF THE HARTREE–FOCK STATE AS MEASURE OF THE PAIRING TENDENCY OF AN INTERACTION. Sharma, S. K.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 275-277 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28746 EFFECTS OF ADDITION OF A NEUTRON ON NUCLEAR PROPERTIES OF p-f SHELL NUCLEI. Parikh, J. K. (Atomic Minerals Div., New Delhi). pp 303-306 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28747 STUDY OF V, Mn, AND Co ISOTOPES. Parikh, J. K. (Atomic Minerals Div., New Delhi). pp 307-310 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28748 STUDY OF ODD–ODD NUCLEI IN 1f–2p SHELL. Dhar, A. K., Kulkarni, D. R. (Physical Research Lab., Ahmedabad, India). pp 321-325 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28749 INTERNAL BREMSSTRAHLUNG FROM ^{45}Ca. Powar, M. S.; Singh, M. (Punjabi Univ., Patiala, India). pp 407-410 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28750 (d,^{6}Li) REACTIONS ON INTERMEDIATE MASS NUCLEI. Martin, P.; Viano, J. B.; Loisequx, J. M.; Chalony, Y. L. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys., A212: No. 2, 304-316(1973).

The (d,^{6}Li) reactions were studied at 28 and 36 MeV on ^{40,42}Ca, ^{56}Fe, ^{58}Ni and ^{114}Sn. In most reactions levels were identified up to 3 to 4 MeV. A DWBA analysis was carried out in the zero-range approximation, assuming simple configurations for the final state. The spectroscopic factors for the ground-state transitions remain fairly constant from ^{40}Ca to ^{114}Sn. Transitions leading to excited states are discussed. (auth)

28751 ^{56}Fe LEVELS POPULATED IN ^{56}Mn DECAY. Ardisson, G.; Marsol, C. (Institut d'Etudes Nucleaires, Algiers). Nucl. Phys., A212: No. 2, 324-328(1973). (In French).

Radioactive decay of ^{56}Mn was reinvestigated using coaxial Ge(Li) detectors. Energies and intensities of ten γ-rays were measured. Gamma-rays of 1238.3 and 2598.6 keV were confirmed; a new γ-ray of 1038.0 keV was found showing that the 3123.1 keV level in ^{56}Fe is fed by β-decay. A 3120 keV level ($J^\pi = 0^+$) was not found to be fed in this decay. (auth)

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Refer also to abstracts 28655, 28668, 28697, 28717, 28740, 28746, 28780, 28820–28821, 28824, 28831, and 28846.

28752 (BMFT-FBK-73-20) REACTIONS ^{68,70}Zn(^{3}He,d)^{69,71}Ga AND ^{68,70}Zn(^{3}He,α)^{67,69}Zn AND LEVEL SYSTEMATICS OF THE ODD-MASS GA-ISOTOPES. David, P.; Riccato, A. (Bonn Univ. (West Germany). Institut fuer Strahlen und Kernphysik). Jul 1973. 102p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The reactions ^{68,70}Zn(^{3}He,d)^{69,71}Ga were studied at $E_{^3He}$ = 15 and 17 MeV with a broad-range magnetic spectrograph and analyzed in terms of the distorted-wave Born approximation. Energies, spins, parities and spectroscopic factors of levels up to about 5 MeV excitation energy were determined for each of the nuclei ^{69,71}Ga and are compared with previous data. Total strengths and centers-of-gravity for the proton single-particle states are presented. Information is obtained about the zinc nuclei ground-state configurations. The systematic trends of the level structure of the odd-mass nuclei ^{65,67,69,71}Ga are discussed and compared with existing theoretical calculations. Only limited agreement is found. Measurements and analyses of the reactions ^{68,70}Zn(^{3}He,α)^{67,69}Zn at $E_{^3He}$ = 15 and 17 MeV are presented. (auth)

28753 (FEI-241) INVESTIGATIONS ON METHODS FOR PRODUCTION OF YTTRIUM-87 AS A STRONTIUM-87 PRODUCER. Krasnov, N. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 19p. (In Russian). INIS.

Three possible methods for the production of ^{87}Y were investigated: Sr + p, Sr + d, and Rb + α. The yield of the isotopes ^{87g}Y, ^{87m}Y and ^{88}Y were measured in dependence on the particle energy (protons and deuterons up to 22.5 MeV and the α particles up to 45 MeV). Formulas and curves for the determination of the activity of ^{87}Y and ^{87m}Sr with use of the values of the isotopic yield were presented. The methods for the production of ^{87}Y with minimum impurity of ^{88}Y were discussed. (tr-auth)

28754 (HEDL-TME-73-63) FAST NEUTRON CAPTURE CROSS SECTIONS FOR FISSION PRODUCT ISOTOPES. Schmittroth, F.; Schenter, R. E. (Hanford Engineering Development Lab., Richland, Wash.). Aug 1973. Contract AT(45-1)-2170. 77p. (ENDF-194). Dep. NTIS $5.45.

Calculated average capture cross sections are given from 10 eV to 15 MeV to be used as a basis for revising and extending the ENDF/B-IV data files. Thirty-nine fission product isotopes, plus ^{197}Au, are included. The results were obtained by statistical model calculations that were adjusted as seemed necessary by the available capture data. For those isotopes studied earlier, the major revision is the use of new estimates for the neutron resonance spacings. Integral cross sections are computed and compared with values from the Coupled Fast Reactivity Measurement Facility (CFRMF). (auth)

28755 SHELL MODEL FOR ROTATION-LIKE SPECTRA OF Sr ISOTOPES. Ogawa, K. (Tokyo Univ.). Phys. Lett., 45B: No. 3, 214-216(23 Jul 1973).

The isotopes of Sr are described by a shell-model with the proton-neutron configurations $(2p_{\frac{1}{2}}, 2p_{\frac{3}{2}}, 1f_{\frac{5}{2}})_p^{-2} \times (1g_{\frac{9}{2}})_n^{-(50-N)}$. The transition of the spectrum from a shell structure to a rotation-like structure which is experimentally observed in the Sr isotopes can be reproduced by the present model. (auth)

28756 MIXING OF THE GIANT MAGNETIC DIPOLE STATE WITH THE 1^+ STATE IN ^{88}Sr AT 3.49 MeV. Cecil, F. E.; Kuo, T. T. S.; Tsai, S. F. (State Univ. of New York, Stony Brook). Phys. Lett., 45B: No. 3, 217-218(23 Jul 1973).

The ground state magnetic dipole transition width from the 1^+ state in ^{88}Sr at 3.49 MeV is calculated using a reasonable wave function for the ground state and a wave function for the 1^+ state calculated by diagonalizing one particle-one hole shell model 1^+ states starting with a basis of reasonable dimensions. The calculated value of the width is 0.17 eV. The measured value is 0.15 ± 0.024 eV. (auth)

28757 SPECTRUM OF γ RADIATION ARISING IN THE REACTION ^{77}Se(n,γ)^{78}Se WITH THERMAL NEUTRONS. Akhmed, M. R.; Demidov, A. M.; Khalil, M. A.; Al'-Nazar, S. (Inst. of Nuclear Research, Baghdad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1004-1006(May 1973). (In Russian).

The spectrum of γ rays from the reaction ^{77}Se(n,γ)^{78}Se with thermal neutrons was measured with a Ge(Li) spectrometer. The energies and intensities of 124 γ lines were determined. A γ transition scheme for ^{78}Se was described. (2 tables) (tr-auth)

28758 SPECTRUM OF γ RADIATION ARISING IN THE REACTION ^{74}Se(n,γ)^{75}Se WITH THERMAL NEUTRONS. Akhmed, M. R.; Demidov, A. M.; Khalil, M. A.; Khussein, F. A. (Inst. of Nuclear Research, Baghdad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 993-997(May 1973). (In Russian).

By means of a Ge(Li) spectrometer the γ-ray spectrum from the (n,γ) reaction with thermal neutrons was measured. The energy and intensity of 152 × γ spectral lines were determined. The γ transition scheme of ^{75}Se was compiled. (1 figure, 2 tables) (tr-auth)

28759 POLARIZATION OF THE γ RADIATION FROM THE (p,nγ) REACTION ON THE NUCLEI ^{54}Cr AND ^{64}Ni. Zalyubovskii, I. I.; Mashali, F.; Mishchenko, V. M.; Popov, A. I.; Storizhko, V. E.; Fedorets, I. D. (Physical-Technical Inst., Kazan). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1076-1079(May 1973). (In Russian).

By means of a Compton polarimeter with stilbene crystals as a scatterer, the linear polarization of the γ rays accompanying the decay of the 156-keV state of ^{54}Mn and the 159-, 278-, and 344-keV states of ^{64}Cu was measured. The levels of ^{54}Mn and ^{64}Cu were populated in (p,n) reactions at proton energies of 3.0 MeV. (2 figures, 1 table) (tr-auth)

28760 NUMERICAL ACCURACY OF ^{3}He OPTICAL-MODEL CALCULATIONS AT 70 MeV. Doering, R. R.; Galonsky, A. I.; Hinrichs, R. A. (Michigan State Univ., East Lansing). J. Comput. Phys.; 12: No. 4, 498-512(Aug 1973).

Small differential cross sections, such as those measured at back angles for 70 MeV ^{3}He elastic scattering (typically below 10^{-4} mb/sr past 130°), are difficult to calculate accurately when they result from considerable cancellation in the partial-wave sum. The codes GENOA, GIBELUMP, SNOOPY3, and DWUCK differ by as much as 2½ orders of magnitude on $\sigma(\theta)$ for an optical-model potential describing ^{60}Ni(^{3}He,^{3}He)^{60}Ni scattering at 71 MeV. This calculation is repeated, with a modified version of GIBELUMP, for wide ranges of the parameters affecting numerical accuracy. A study of errors in scattering matrix elements and cross sections, as functions of these parameters, reveals that criteria commonly used to determine the matching radius and number of partial waves employed in optical-model calculations yield insufficient values in this case. (auth)

28761 SCATTERING CROSS SECTIONS FROM MONOENERGETIC PHOTONS ON STRONTIUM IN THE ENERGY REGION 8.6 TO 12.0 MeV. Datta, S. Urbana, IL; Univ. of Illinois (1972). 139p. University Microfilms Order No. 73-17,174.

Thesis (Ph. D.).

Monoenergetic gamma rays from the University of Illinois bremsstrahlung monochromator were used to measure the cross sections for elastic scattering and for inelastic scattering to the first excited state of ^{88}Sr. The incident gamma rays were selected in energy bins of about 100 keV in the energy region between 8.6 and 12 MeV. The cross sections show some similarities with those reported for photon scattering from ^{90}Zr. There are several maxima and minima in the cross sections. The most prominent maximum in the elastic scattering occurs at about 9.48 MeV. This roughly coincides with the excitation energy of the prominent E1 state predicted by Goulard, Hughes, and Fallieros. The cross section shows a rising trend below the photo-neutron threshold. This trend is probably due to the large E1 state predicted by Goulard et al., to be at 11.87 MeV. A sharp drop is observed at about 11.55 MeV which corresponds to the effective photo-neutron threshold at 11.53 MeV. The elastic scattering cross sections were used to estimate the total photon interaction cross sections. The estimated total cross sections are not inconsistent with the Lorentz tail extrapolation of the giant dipole resonance. However, the magnitudes of these cross sections are much smaller than the theoretical estimates of Goulard et al. (Diss. Abstr.)

28762 MULTISTEP CONTRIBUTIONS IN ^{88}Sr(h,t)^{88}Y. Coker, W. R.; Udagawa, T.; Wolter, H. H. (Univ. of Texas, Austin). Phys. Lett.; 46B: No. 1, 27-30(3 Sep 1973).

Using a coupled-reaction-channels (CRC) description of nuclear reactions, the reaction ^{88}Sr(h,t)^{88}Y to 4^-, 5^-, and 2^+,3^+ doublet states was studied. The data, taken at 23 MeV, show angular distributions with anomalous shapes, which cannot be explained by simple distorted-wave Born approximation calculations; the calculations, including (h,α) – (α,t) and (h,d) – (d,t) intermediate processes, but neglecting the direct (h,t) mechanism, give a good description of the shapes and relative magnitudes of the angular distributions. Effects of configuration mixing are also studied. (auth)

28763 SYSTEMATIC STUDY OF THE ^{88}Sr(^{16}O,^{15}N) REACTION: EVIDENCE FOR RECOIL EFFECTS. Anantaraman, N.; Katori, K.; Koerner, H. J. (Argonne National Lab., IL). Phys. Lett.; 46B: No. 1, 67-69(3 Sep 1973).

Angular distributions for the ^{88}Sr(^{16}O,^{15}N) reaction leading to the $2p_{\frac{1}{2}}$ and $1g_{\frac{9}{2}}$ states in ^{89}Y were measured at several incident energies below and above the Coulomb barrier. Comparison and no-recoil DWBA calculations reveals an energy-dependent normalization for the transition to the $2p_{\frac{1}{2}}$ state. This energy dependence disappeared, however, in a recent DWBA calculation made by Tamura and Low, which included recoil effects. (auth)

28764 LEVEL STRUCTURE OF NEUTRON-DEFICIENT Br ISOTOPES. Houdayer, A. J. Montreal; McGill Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The decay of $^{74-75-76-77}$Kr was investigated by means of beta gamma spectroscopy. A technique of rapid separation of krypton was developed and adapted to a glow discharge chamber to produce thin Kr conversion electron sources. Gamma-ray energy, relative intensity and gamma-gamma coincidence measurements permit the construction of a decay scheme for each of the $^{74-75-76-77}$Kr nuclei. The half-lives of these nuclides were measured. The spin-parity assignments to the various states in the bromine isotopes were made with the help of the deduced log ft values and the measured internal conversion coefficients. The intermediate coupling model was used to describe the level structure and electromagnetic properties of the odd-mass $^{77-79-81-83}$Br isotopes. The predictions of the model agree well with the experimental data. (Diss. Abstr.)

28765 STUDY OF THE EXCITED STATES OF SOME SPHEROIDAL NUCLEI. Paradellis, T. P. Regina, Saskatchewan; Univ. of Saskatchewan (1970). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The decay of ^{75}Se, ^{78}As, and ^{92}Y was investigated by means of high resolution Ge(Li) detectors. The accurate relative efficiency calibration of a variety of Ge(Li) detectors was used to test a semi-empirical relative efficiency equation. It was found that the relative efficiency of a particular detector may be expressed through an equation relating the efficiency with the photoelectric and Compton coefficients of germanium, the active volume of the detector and the energy of the detected photons. Single and coincidence spectra revealed the existence of three previously unobserved gamma rays in ^{75}Se at 24.4, 81.0 and 468.6 keV. The accurate intensity data obtained here were combined with conversion electron intensity and half-life data available in the literature to obtain accurate conversion coefficients and transition rates in ^{75}As. The ^{78}As activity was produced via the ^{78}Se(n,p)^{78}As and ^{81}Br(n,α)^{78}As reactions using the ^{14}MeV flux of a neutron generator. Thirty-one gamma rays were observed in the decay of ^{78}As, most of them for the first time. A decay scheme is proposed including ^{16} excited states in ^{78}Se. The ^{92}Y activity was produced via the ^{92}Zr(n,p)^{92}Y reaction. The decay of ^{92}Y was investigated for the first time by means of high resolution Ge(Li) detectors. Twelve transitions were observed in the decay of ^{92}Y and an improved decay scheme is presented including six excited states. The intermediate coupling model was used to interpret the obtained data. The model is formulated, extended and tested on the odd Xe isotopes. It was found that the model describes well the observed properties of these isotopes. A good description of both positive and negative parity states in ^{75}As is obtained if an extra term $H' = g\vec{I}\vec{R}$ is added in the Hamiltonian of the intermediate coupling model, where g is a constant and $\vec{I},\vec{R}$ the angular momenta of the extra core particle and core, respectively. This term gives rise to several positive parity states which have been recently observed in ^{83}Rb. Finally, it was found that the observed excited states of ^{92}Zr can be well reproduced by the intermediate coupling model. The ^{92}Zr nucleus is considered to be described by ^{90}Zr vibrating core to which two $2d_{5/2}$ neutrons are coupled. The observed half life of the first 2^+ collective state in ^{92}Zr is reproduced well by the model. The level structure of ^{79}Se is interpreted in terms of collective and quasiparticle excitations. (Diss. Abstr.)

28766 INITIAL VERIFICATION OF THE (2γ,n) REACTION IN ^{63}Cu USING THERMAL-NEUTRON-CAPTURE GAMMA RAYS. Nha, S. K. Columbia, MO; Univ. of Missouri (1972). 212p. University Microfilms Order No. 73-21,470.

Thesis (Ph. D.).

The first observation of a (2γ,n) reaction in ^{63}Cu was made using thermal-neutron-capture gamma rays at energies of 5.58, 6.072, 6.753, 7.724, 7.914, 8.881, and 8.997 MeV. The spectra of the positron annihilation radiation following the photodisintegration process were measured with two NaI(Tl) crystals in coincidence. Several different experiments were performed to insure the observed activities were not due to (n,2n) reaction in ^{63}Cu. Appreciable cross sections of 5.32, 2.59, 1.31, and 2.85 microbarns were obtained at energies of 6.072, 6.753, 7.724, and 8.997 MeV, respectively. No observable cross sections were obtained at 5.58, 7.914, and 8.881 MeV. Analytic expressions for the mechanism of a two-step reaction process, (2γ,n), were derived using a distorted-wave theory. The measured cross sections agreed in magnitude with those predicted by this theory. Further experiments to verify the (2γ,n) reaction in other nuclei are suggested. (Diss. Abstr.)

28767 EVIDENCE FOR CORE EXCITATION IN ^{79}Br AND ^{81}Br. Chopra, R. C. (Tata Inst. of Fundamental Research, Bombay). pp 171-175 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28768 SUM-COINCIDENCE STUDIES IN THE DECAY OF ^{59}Fe. Chaturvedi, L.; Prasad, R.; Ram, S. P.; Chaturvedi, S. N.; Nigam, A. K. (Banaras Hindu Univ., India). 355 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28769 DECAYS OF 3.75-MIN ^{68m}Cu AND 30-SEC ^{68m}Cu Tikku, V. K.; Singh, H.; Sethi, B. (Saha Inst. of Nuclear Physics, Calcutta). pp 357-361 of Proceedings of the nuclear physics and solid state physics symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28770 CONVERSION-ELECTRON STUDIES OF EXCITED STATES IN ^{74}As FROM THE ^{74}Ge(p,ne)^{74}As REACTION. Agarwal, Y. K.; Bharathi, S. M.; Bhattacherjee, S. K.; Lal, B.; Sahai, B. (Tata Inst. of Fundamental Research, Bombay). pp 379-384 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28771 ELECTROMAGNETIC PROPERTIES OF LOW-LYING LEVELS IN ^{75}As. Chopra, R. C.; Tandon, P. N. (Tata Inst. of Fundamental Research, Bombay). pp 427-430 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28772 DIRECTIONAL CORRELATIONS OF GAMMA-GAMMA CASCADES IN ^{75}As. Gupta, S. L.; Bajaj, M. M.; Saha, N. K. (Univ. of Delhi). pp 431-434 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28773 LEVEL STRUCTURE STUDIES IN ^{75}As AND ^{131}Xe. Singh, N.; Bhati, S. S.; Dhingra, R. L.; Trehan, P. N. (Panjab Univ., Chandigarh, India). pp 435-439 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28774 DECAY OF ^{75}Se. Sastry, B. R.; Narasimham, K. L.; Sastry, D. L. (Andhra Univ., Visakhapatnam, India). 441 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28775 MIXING RATIOS IN ^{59}Co DETERMINED BY GAMMA-GAMMA ANGULAR CORRELATIONS. Eriksson, L.; Gidefeldt, L. (Univ. of Stockholm). Phys. Scr.; 7: No. 4, 169-172(1973).

The E2/M1 mixing ratios of the 142.5, 192.2 and 334.7 keV transitions in ^{59}Co are determined with the gamma-gamma angular correlation technique, by use of a 56-channel goniometer. The results are $\delta_{142.5} = -0.006\,(12)$, $\delta_{192.2} = 0.21\,(2)$ and $\delta_{334.7} = -012\,(4)$. The mixing ratios and the associated E2 and M1 transition probabilities are compared with the predictions from a unified vibrational model. An upper limit of 0.9 per cent is found for the M3 admixture in the 1,291.5 keV transition. (auth)

28776 SECONDARY PARTICLES PRODUCED IN THE INTERACTION OF MULTIPLY CHARGED RELATIVISTIC NUCLEI WITH EMULSION NUCLEI. Dudkin, V. E.; Potapov, Yu. V.; Khokhlova, Z. S.; Shimanskaya, N. S.; Yakovlev, R. M. Yadern. Fiz.; 18: No. 2, 374-376(Aug 1973). (In Russian).

Nucleus-nucleus interactions at high energies have been studied by means of nuclear emulsions. Some results for the light (H, C, N, O) and heavy (Ag, Br) emulsion nuclei are presented. Spectra of slow two-charge particles can not be explained with separate nucleon-nucleus collisions. (auth)

28777 LEVEL STRUCTURE OF ^{78}Se. Hinrichsen, P. F.; Kennedy, G.; Paradellis, T. (McGill Univ., Montreal). Nucl. Phys., A212: No. 2, 365-381(1973).

Gamma-transitions in ^{78}Se following the β^+ decay of ^{78}Br were studied using Ge(Li) detectors. Twenty γ-rays of which five were previously unreported, were assigned to this decay, while five previously reported transitions were not confirmed. The half-life was determined as $t_{\frac{1}{2}} = 6.46 \pm 0.04$ min. The level energies were determined from inelastic proton scattering and a detailed comparison with the level structure deduced from ^{78}As decay and reaction data was made. The 1498.5 keV and 1502.2 keV levels are identified as the first 0^+ and 4^+ levels respectively, and the octupole 3^- state was found at 2507.9 keV. (auth)

28778 SELF-CONSISTENT STUDY OF SOME EVEN–EVEN ISOTOPES OF Zn, Ge, AND Se. Sharma, S. K.; Khadkikar, S. B. (Physical Research Lab., Ahmedabad, India). pp 327-330 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28779 CUMULATIVE MESOPRODUCTION. Baldin, A. M.; Gerasimov, S. G.; Giordeneski, N.; Zubarev, V. N.; Ivanova, L. K.; Kirillov, A. D.; Kuznetsov, V. A.; Moroz, N. S.; Radomanov, V. B.; Ramzhin, V. N.; Stavinskii, V. S.; Yatsuta, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 79-85(Jul 1973). (In Russian).

Probability of production of mesons induced by accelerated deuterium nuclei is measured. The produced pion energy is more than the energy of a nucleon in the deuteron beam. The ratio of the cross section of the pion production induced by deuterium nuclei to the cross section of the pion production induced by nucleons at an equal energy release does not depend on the ratio of the pion momentum to the maximal value allowed by the kinematics, nor on the primary deuteron energy. The ratio equals to 0.06. This quantity and its energy dependence cannot be explained by means of the Fermi motion. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 27401, 28344, 28655, 28729, 28730, 28733, 28750, 28754, 28765, 28773, 28776, 28786, 28840, 28842, 28851, and 28867.

28780 (AED-CONF-71-400, pp 161-175) COMPARATIVE MEASUREMENT OF NEIGHBORING ISOTOPES AND ISOTONES. Wohlfahrt, H. D. (Univ., Mainz). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Even small differences in the elastic cross section of neighboring nuclei can be measured reliably with improved techniques, such as rapidly changing targets, single pulse charge measurements, and monitor spectrometers. Preliminary results of such measurements are reported in the region of iron and molybdenum nuclei. The model-independent procedure for data evaluation is discussed. (6 figures) (tr-auth)

28781 (AED-CONF-71-400, pp 217-226) NEUTRON CAPTURE IN THE RESONANCE REGION. Weigmann, H. (EURATOM, Geel, Belgium). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

The measurement of gamma spectra which occur after neutron capture in the isolated resonances of the compound nucleus is discussed. These measurements permit the determination of resonance spins and parities, as well as furnish information about the capture mechanism. The discussion emphasizes particularly the problem of correlations between various partial widths and their interpretation by means of simple structures in the compound nucleus. (tr-auth)

28782 (BNL-50374) EVALUATED NEUTRON CROSS SECTIONS FOR THE STABLE ISOTOPES OF XENON. Bhat, M. R.; Mughabghab, S. F. (Brookhaven National Lab., Upton, N. Y.). Feb 1973. Contract AT(30-1)-16. 48p. (ENDF-185). Dep. NTIS $5.45.

This report describes an evaluation of the neutron cross section data for the nine stable isotopes of xenon. This evaluation was presented to the Cross Section Evaluations Working Group for approval and inclusion in the ENDF/B Data File. (auth)

28783 (CEA-CONF-2340) ^{16}O INDUCED TRANSFER REACTIONS NEAR THE COULOMB BARRIER ON Sm AND Yb ISOTOPES. Cassagnou, Y.; Lamehi-Rachti, M.; Levi, C.; Mittig, W.; Papineau, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 9p. (CONF-730312-11). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The oxygen-16 induced transfer reactions on ^{144}Sm, ^{152}Sm, ^{170}Yb, ^{171}Yb, ^{174}Yb, and ^{176}Yb were investigated. Energy spectra, cross sections, Q values, and angular distributions were studied. (JFP)

28784 (CEA-CONF-2341) ^{90}Zr(^{16}O,^{12}C)^{94}Mo REACTION. Bonche, P.; Cassagnou, Y.; Faraggi, H.; Jaffrin, A.; Legrain, R.; Morrison, G.; Papineau, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 7p. (CONF-730312-10). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The energy spectra of the ^{90}Zr(^{16}O,^{12}C) reaction was measured at different energies from 51 to 62 MeV and at various angles. Differential cross sections were found. It appears that the observed levels must have a component built with four strongly correlated nucleons populating the various orbitals of the same major shell and that this type of characteristic structures is concentrated on a limited set of levels with small mixing with the underlying continuum. (JFP)

28785 (CEA-CONF-2343) SEMI-PHENOMENOLOGICAL INTERPRETATION OF THE GIANT DIPOLE RESONANCE WIDTH. Carlos, P.; Bergere, R.; Veyssiere, A.; Beil, H.; Lepretre, A.; Miniac, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 2p. (CONF-730301-11). Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

A formula is given for the giant dipole resonance width for heavy deformed and quasi-vibrational nuclei. (JFP)

28786 (CONF-721231-) PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM. Volume 15B. Nuclear Physics. Conference Held at Chandigarh, India, December 28, 1972–January 1, 1973. (Department of Atomic Energy, Bombay (India)). 1972. 566p.

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972).

Papers were presented at this symposium on the subjects of nuclear reactions, nuclear theory, nuclear spectroscopy, and new experimental methods and techniques. Each of the complete papers included in this volume has been separately title listed. (RWR)

For title listings of individual papers see: 27028, 27182, 27427–27430, 27923, 27955, 27965, 27975–27977, 28395, 28488, 28646–28652, 28690–28696, 28719–28725, 28740–28749, 28767–28774, 28778, 28819–28827, 28850–28853, 28866–28869, 28894–28896, 28949–28966, 29103, and 29222.

28787 (COO-3160-4) EXPERIMENTAL STUDY OF NUCLEAR ISOMERS. Final Report. Clark, D. D. (Cornell Univ., Ithaca, N. Y. Nuclear Reactor Lab). Apr 1973. Contract AT(11-1)-3160. 22p. Dep. NTIS $3.25.

A program of experimental investigations of nuclear isomers was supported by the AEC from March 1, 1966 through August 31, 1971, with no-funds extensions to June 30, 1972. Results can be grouped into three phases: (1) isomers in the 10 ms to 10 sec half-life range studied with a pulsed TRIGA reactor and fast rabbit; (2) multipolarity determination of low energy highly converted transitions; and (3) feasibility studies of shape isomer experiments using neutrons. In phase 1, In^{114m}, In^{116m}, Xe^{125m}, Xe^{127m}, Ba^{136m}, Gd^{155m}, Dy^{157m}, Ta^{182m}, and Ir^{194m} were investigated along with two new isomers Xe^{134m} and Sm^{153m} In phase 2, a new method of determining multipolarity based on relative L x-ray intensities was developed and applied. Extensive tables of theoretical values of atomic fluorescence and radiationless transition probabilities were calculated. In phase 3, valuable neutron-beam shape isomer investigations were found feasible but only with a new experimental approach. A new instrument, the inner shell vacancy (ISV) detector, was conceived, developed, and tested successfully in bench model form, but contract termination and inadequate funds forestalled completing a model for shape isomer experiments. In one test, the ISV detector enabled measurement of the half-life of the 1.28-keV level of Ag^{110}. Lists of talks, reports, publications, and citations are appended. (auth)

28788 (KFK-1806) EXCITATION FUNCTIONS FOR (α,xn)- AND (α,pxn)-REACTIONS WITH Mo ISOTOPES. Graf, H. P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). May 1973. 49p. (In German). Dep. NTIS (U.S. Sales Only) $4.50.

Thesis. Submitted to Technische Hochschule, Karlsruhe (Wes. Germany).

Excitation functions for (α,xn)-reactions x = 1,2,3 and (α,pxn)-reactions x = 0,1,2 with Mo-isotopes were measured. Thin foils of natural Mo served as target. For some reactions enriched iso-

topes were irradiated using copper as a monitor. The maximum cross section σ_{max}, representing one of the characteristic magnitudes of excitation functions is compared with the systematic of (α,xn)-reactions. Furthermore the experimental results were compared to calculations based on the statistical model. (auth)

28789 (LBL-1914) FISSION PROBABILITIES IN LIGHTER NUCLEI. A Theoretical and Experimental Investigation of the Shell and Pairing Effects in Fissioning Nuclei. Moretto, L. G. (California Univ., Berkeley. Lawrence Berkeley Lab). Jul 1973. Contract W-7405-Eng-48. 62p. (CONF-730823-16; SM-174/204). Dep. NTIS $5.25.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The general features of the fission probabilities are reviewed in the light of the modern developments on the statistical properties of nuclei. The general thermodynamical aspects of the fission probabilities are first discussed without relying on any specific nuclear model. The effects of the shell structure and of the collective degrees of freedom on the saddle-point and ground state phase space volume are then considered. A general method to include the effect of shells and pairing in the fission probability calculation is illustrated. The disappearance of the shell and pairing effects with increasing excitation energy and its influence on the fission probabilities is exemplified by means of a calculation performed on superheavy elements. The experimental data available in nuclei in the Pb region and lighter nuclei are discussed in detail, and an analysis based upon the present knowledge of shell and pairing effects is performed. It is found that the experimental evidence on shell effects in these data are accounted for satisfactorily by including the Nilsson model and the BCS Hamiltonian in the calculation. A reliable set of fission barriers is obtained and the liquid drop model predictions are tested. The saddle point single particle level densities which are also obtained in the analysis show the expected A dependence and their magnitude, about 8% larger than the corresponding ground state quantity, seems to be due to an increase in the nuclear surface at the saddle point. (auth)

28790 (LYCEN-7302, pp S9.1-S9.2) SHAPE TRANSITIONS IN MOLYBDENUM NUCLEI. Sharma, H. L. (Univ. of Minnesota, Minneapolis); Seltz, R.; Hintz, N. M. 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The ^{100}Mo(p,t)^{98}Mo reaction was studied at 19 MeV in view of finding a possible rotational band built on the first excited 0^+ level of ^{98}Mo. The results do not establish the existence of such a band. (FR)

28791 (LYCEN-7302, pp S20.1-S20.4) MICROSCOPIC CALCULATIONS OF PROTON INELASTIC SCATTERING CROSS SECTIONS FOR THE COLLECTIVE LEVELS OF CLOSED-SHELL ISOTOPES. Terrien, Y. (CEN de Saclay, Gif-sur Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The starting point of the discussion is the fact that nuclear form factors have been established from the macroscopic model to have an imaginary component. An imaginary term is added to the microscopic real form factor, the imaginary part of the collective form factor being used. This method was applied to calculations of (p,p') scattering on the lowest 2^+ and 3^- levels of nuclei having an open shell (^{118}Sn and ^{116}Sn). (FR)

28792 (LYCEN-7302, pp S21.1-S21.3) (p,t) REACTION WITH EVEN TELLURIUM ISOTOPES. Seltz, R. (CNRS, Strasbourg); Hintz, N. M. 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

A systematic study was undertaken on (p,t) reactions with even tellurium isotopes (A = 120, 122, 124, 126, 128, and 130) in order to determine the characteristics of weakly excited levels of these nuclei and, in particular, to establish the position of the first excited 0^+ levels predicted by the vibrational collective model. (FR)

28793 ELASTIC SCATTERING OF ^{60}Co GAMMA RADIATION FROM HEAVY NUCLEI. Weber, B. New York; City Univ. (1972). 110p. University Microfilms Order No. 73-2859.

Thesis (Ph. D.).

When 1 MeV gamma radiation passes through high Z materials, four separate elastic scattering processes can occur. The four processes are: nuclear Thomson scattering, nuclear resonance scattering, nuclear Delbruck scattering and atomic Rayleigh scattering. The differential cross section was measured for the elastic scattering of ^{60}Co gamma rays from Pb, Sn, and Hg; and then compared with a theoretically predicted cross section to the extent that it could be readily calculated. The results show that the theoretical calculations are in general agreement with the experimentally determined cross section, but that obvious discrepancies exist due to the incompleteness of these theoretical calculations. Better calculations are, therefore, needed in order to establish the relative contributions of these various processes. (Diss. Abstr. Int., B)

28794 BETA–GAMMA–GAMMA ANGULAR CORRELATION STUDIES OF THE RADIATIONS FROM THE DECAY OF ^{124}Sb. Dahiya, H. S.; Singh, B. P. (Univ. of Roorkee, India). Proc. Indian Acad. Sci., Sect. A; 77: No. 5, 226-238(May 1973).

Beta → gamma → gamma angular correlation studies were done for the following two cascades in ^{124}Te from the decay of ^{124}Sb: beta rays of E_{max} = 622 keV → gamma rays of 1691 keV → gamma rays of 603 keV; beta rays of E_{max} = 222 keV → gamma rays of 2091 keV → gamma rays of 603 keV. The multipolarities of the 1691- and 2091-keV gamma rays were determined and spins of the excited levels were confirmed by the beta → gamma → gamma angular correlation technique. (5 figures) (auth)

28795 NUCLEAR DATA SHEETS FOR A = 141. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data, Sect. A; 10: No. 2, 151-204(Aug 1973).

Nuclear structure data for A = 141 isobars are compiled, and adopted level properties and decay schemes are presented. All data available through May 1973 were considered for the present compilation. The first section consists of drawings summarizing essentially all of the available reaction and radioactivity data. These are followed by "Summary Sheets" giving adopted level properties, including bases for J^π assignments and normalization factors used in constructing decay schemes, and adopted gamma-ray properties. The third section, "Data Sheets," lists all data used in obtaining the adopted values. (auth)

28796 NUCLEAR DATA SHEETS FOR A = 97. Medsker, L. R. (Argonne National Lab., IL). Nucl. Data, Sect. A; 10: No. 1, 1-46 (Jul 1973).

The 1960 version of the Nuclear Data Sheets for A = 97 was revised on the basis of experimental data received prior to May 1973. Information from approximately 140 papers and communications was included in the present compilation. (auth)

28797 NUCLEAR DATA SHEETS FOR A = 101. Todd, R.; Kelley, W. H.; Bernthal, F. M.; McHarris, W. C. (Michigan State Univ., East Lansing). Nucl. Data, Sect. A; 10: No. 1, 47-89(Jul 1973).

The 1961 version of the Nuclear Data Sheets for A = 101 was revised on the basis of experimental data published prior to September 1, 1972. The present evaluation contains information obtained from approximately 70 papers. There are currently nine nuclei known for A = 101. Only the presumed ground states and half-lives have been determined for ^{101}Zr and ^{101}Cd. Decay-scheme studies of ^{101}Zr and ^{101}Cd have established two levels in ^{101}Nb and ^{101}Ag, respectively. The identification of levels in ^{101}Mo and some subsequent spin and parity assignments depend primarily on recent sub-Coulomb stripping results. The identification of levels in ^{101}Mo fed by the β decay of ^{101}Nb is somewhat uncertain at this time. Nine levels in ^{101}Pd have been identified from the β-decay study of ^{101}Ag, but the data are not sufficient to assign spins and parities. ϵ/β^+-decay studies of ^{101}Pd have established approximately 19 levels in ^{101}Rh, and have resulted in some tentative spin and parity assignments. During the course of the compilation, results concerning the β decay of ^{101}Mo were communicated to the compilers. This work resulted in the identification of 152 transitions and the placement of approximately 45 levels in ^{101}Tc. In addition, conversion-electron work resulted in the identification of previously unobserved levels in ^{101}Tc at 0.009317 and 0.015601 MeV, requiring a reassignment of level energies in ^{101}Tc. The stable nucleus ^{101}Ru has been studied via β-decay, γ-decay, and Coulomb excitation. As a result, a number of spin assignments for low-lying states are firm. Some additional gaps and uncertainties remain in the data. The relative intensities of transitions depopulating the same levels in ^{101}Ru as observed in β-decay, Coulomb-excitation and γ-decay studies do not agree in some cases. Reaction studies would help to confirm the spins of low-lying states in ^{101}Tc and ^{101}Rh and provide additional information on higher-spin states in ^{101}Mo. The existing data on levels in ^{101}Pd populated by the β decay of ^{101}Ag were obtained in early work with semiconductor detectors and are probably incomplete at this time. (auth)

28798 METHOD FOR IDENTIFICATION OF THE NUCLEAR COLLECTIVE MODES. Kurepin, A. B. (Inst. for Nuclear Research, Moscow); Lombard, R. M.; Raynal, J. Phys. Lett., 45B: No. 3, 184-186(23 Jul 1973).

The analyzing power measurements for inelastic scattering of polarized protons with excitation of the first 2^+ level provide a sensitive method to distinguish two simple collective models-axially symmetric rotational and vibrational. The method is illustrated by the measurements of 24.5-MeV protons scattering on ^{148,152}Sm and some coupled channel calculations. (auth)

28799 TEST FOR TIME-REVERSAL VIOLATION IN ALLOWED ISOSPIN HINDERED BETA-DECAY. Barroso, A.; Blin-Stoyle, R. J. (Univ. of Sussex, Eng.). Phys. Lett., 45B: No. 3, 178-180(23 Jul 1973).

A method is proposed for the detection of T-violation in allowed isospin-hindered β-decay which is relatively simple from the point of view of theoretical analysis and which introduces an amplification of the T-violating effect of $\approx 10^2$. As an example a β-decay in ^{134}Cs is studied. (auth)

28800 ROLE OF THE IMAGINARY PART IN THE MICROSCOPIC DESCRIPTION OF (p,p') SCATTERING. Terrien, Y. (CEN de Saclay, Gif-sur-Yvette, France); Escudie, J. L.; Buenerd, M.; Loiseaux, J. M.; Martin, P.; Viano, J. B. Phys. Lett., 45B: No. 3, 235-237(23 Jul 1973).

A (p,p') scattering experiment at $E_p = 40$ MeV was performed on the targets ^{92}Mo and ^{116,120,124}Sn. The addition of a simple collective imaginary form factor to the microscopic real form factor provides an important improvement in the agreement between calculated and experimental cross sections for the lowest 2^+ and 3^- states. Results concerning the $\Delta T = 1$ and $\Delta T = 0$ contributions to the transitions are discussed. (auth)

28801 GENERAL SCIENTIFIC MEETING, LIEGE, BELGIUM, JUNE 7-8, 1972. Liege; Royal Society of Science (1972). 112p. (In several languages). (CONF-720688-(Absts.)).

From general scientific meeting; Liege, Belgium (7 Jun 1972).

Abstracts of the papers presented at the general meeting are given. Session names and numbers of abstracts are as follows: Nuclear Physics, 23; Atomic and molecular physics, 14; Solid state physics, 23; Elementary particle physics, 7; Plasma physics, 10; and Quantum electronics, 10. (RWR)

28802 SPECTRUM OF γ RADIATION ARISING DURING CAPTURE OF THERMAL NEUTRONS BY ^{96}Mo, ^{98}Mo, AND ^{100}Mo. Demidov, A. M.; Akhmed, M. R.; Khalil, M. A.; Al'-Nazar, S. (Inst. of Atomic Energy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 998-1003(May 1973). (In Russian).

The spectra of γ rays arising during capture of thermal neutrons by ^{96}Mo, ^{98}Mo, and ^{100}Mo were measured with a Ge(Li) spectrometer. The energies and intensities of the γ lines were determined. The γ transition schemes of the nuclei ^{97}Mo and ^{99}Mo were constructed. (2 figures, 4 tables) (tr-auth)

28803 DETERMINATION OF THE ENERGY OF THE ELECTRON-CAPTURE DECAYS ^{134}Ce → ^{134}La AND ^{160}Er → ^{160}Ho. Aleksandrov, V. S.; Buttsev, V. S.; Vylov, Ts.; Gromov, K. Ya.; Kalinnikov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 948-952 (May 1973). (In Russian).

The method used for the determination of the decay energy appears practically unique for chain decay. The values obtained were $Q_\varepsilon(^{134}\text{Ce} \rightarrow {}^{134}\text{La}) = 110^{+80}_{-30}$ keV and $Q_\varepsilon(^{160}\text{Er} \rightarrow {}^{160}\text{Ho}) = 310^{+120}_{-70}$ keV. (4 figures) (JSR)

28804 INVESTIGATION OF THE DECAY OF ^{137}Nd (38.5 min). Isomers of the Nucleus ^{137}Nd. Buttsev, V. S.; Vylov, Ts.; Gromov, K. Ya.; Kalinnikov, V. G.; Gromova, I. I.; Morozov, V. A.; Muminov, T. M.; Fuya, Kh.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 953-964(May 1973). (In Russian).

By means of a special spectrometric device, the decay of ^{137}Nd was investigated. A decay scheme was proposed for ^{137}Nd → ^{137}Pr, in which 37 new levels were introduced. (6 figures, 3 tables) (tr-auth)

28805 THREE-PARTICLE AND "ANOMALOUS" EXCITED STATES OF THE NUCLEUS ^{101}Tc. Aldushchenkov, A. V.; Voinova, N. A.; Dubro, V. G.; Egorov, A. I.; Kalinichev, Yu. V.; Kaminker, D. M.; Deker, L. K.; Sergeev, A. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 965-971(May 1973). (In Russian).

The decay ^{101}Mo (14.6 min) → ^{101}Tc was investigated by means of Ge(Li) and Si(Li) detectors; the γ spectrum and the absolute value of the internal conversion coefficient were measured. 55 transitions were found, and their energy and intensity were determined. A level scheme for ^{101}Tc was constructed. (2 figures, 2 tables) (tr-auth)

28806 EMISSION SPECTRA AND DECAY SCHEME OF ^{137}Pr. Buttsev, V. S.; Gromov, K. Ya.; Kalinnikov, V. G.; Morozov, V. A.; Muminov, T. M.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 938-947(May 1973). (In Russian).

The γ-ray, conversion and β^+ electron, and $\gamma\gamma$ coincidence spectra were measured. In the proposed scheme of ^{137}Ce the following new levels were introduced: 1105.2, 1258.9, 1271.5, 1288.5, 1476.6, 1925.2, 1933.9, 2113.4, 2347.2, and 2480.0 keV. The lifetime of the ^{137}Ce state at 160.32 keV was measured as $T_{\frac{1}{2}} = 0.79 \pm 0.14$ ns. The nature of the level was discussed. (5 figures, 2 tables) (tr-auth)

28807 SPECTRA OF γ RADIATION ARISING DURING THE CAPTURE OF THERMAL NEUTRONS BY THE NUCLEI ^{94,96,98,100}Mo. Barchuk, I. F.; Belykh, G. V.; Golyshkin, V. I.; Murzin, A. V.; Ogorodnik, A. F. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1080-1082 (May 1973). (In Russian).

The energy and intensity of the hard γ emission during the capture of thermal neutrons by ^{94,96,98,100}Mo were measured; and the results, tabulated. (2 tables) (JSR)

28808 DECAY ^{134}La → ^{134}Ba. Aleksandrov, V. S.; Dzhelepov, B. S.; Medvedev, A. I.; Ter-Nersesyants, V. E.; Uchevatkin, I. F.; Shestopalova, S. A. (All-Union Scientific Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1035-1051(May 1973). (In Russian).

The hard components of the β spectrum of ^{134}La, the K electron conversion spectra, γ emission, and $\gamma\gamma$ coincidences were measured. The conversion coefficients of a series of transitions were determined. As a result of a critical analysis of all published works, recommended values of the energy and relative intensities of the γ emission were introduced. On the basis of all compiled data the decay scheme for ^{134}La → ^{134}Ba was made more precise. (3 figures, 6 tables) (tr-auth)

28809 EXCITED QUASI-PROTON STATES IN THE MAGIC NUCLEUS ^{141}Pr. Buttsev, V. S.; Gromov, K. Ya.; Kalinnikov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1024-1034(May 1973). (In Russian).

The γ-ray, x-ray, $\gamma\gamma$-coincidence, and conversion electron and positron spectra of ^{141}Nd(2.42 ± 0.09 hr) were studied in detail. Three new γ transitions were detected. The energies of the γ transitions of ^{141}Pr were made significantly more precise. The quantum characteristics of the levels of ^{141}Pr were established. (4 figures, 2 tables) (tr-auth)

28810 CORRELATION EFFECTS AND STABILITY OF THE SOLUTION OF THE INVERSE PROBLEM DURING PROCESSING OF THE RESULTS OF THE INVESTIGATION OF PHOTONUCLEAR PROCESSES IN BREMSSTRAHLUNG. Orlin, V. N. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1107-1119(May 1973). (In Russian).

The cross section of the photonuclear processes was determined from experimental data. The statistical properties of the solution obtained for the cross section were studied. It was shown that under some conditions the cross section found can have elements of a spurious fluctuation structure. A method for the suppression of such structures, based on the decrease of the correlation coupling between isolated values of the calculated cross section, was described. (4 figures) (JSR)

28811 DISTRIBUTION OF ELECTRIC DIPOLE STRENGTH IN ^{90}Zr BETWEEN 8.6 AND 13.2 MeV STUDIED VIA PHOTON SCATTERING. Ganek, D. E. Urbana, IL; Univ. of Illinois (1972). 132p. University Microfilms Order No. 73-17,213.

Thesis (Ph. D.).

The average elastic cross section for scattering of photons by ^{90}Zr in the energy region of 8.6 to 13.2 MeV was measured with 3/4% energy resolution; also measured was the inelastic scattering cross section to the first excited state of ^{90}Zr. The University of Illinois Bremsstrahlung Monochromator facility was used as a source of monochromatic photons. The measured elastic scattering cross section and the photoproton cross section derived from other measurements were used to infer the total interaction (absorption) cross section in the energy region of 8.6 to 12.5 MeV (effective neutron threshold). The total integrated cross section in this energy region was equal to 55 MeV-mb, which is about 5% of the classical dipole sum rule. The shape and magnitude of the total interaction cross section above 11 MeV agree fairly well with an extrapolation of a Lorentz line fit to the giant dipole resonance of ^{90}Zr. Below 11 MeV there is evidence of an excess of dipole strength, although the magnitude of this strength is much less than predicted by theoretical calculations. There is evidence of a narrow resonance near 9.14 MeV and a 200 keV wide resonance near 11.5 MeV. Correlations between the partial widths for photon decay and proton decay in the energy region of 10.5 to 12.5 MeV were not evident. The scattering data were accumulated on-line with the aid of the laboratory's PDP-15/30 digital computer. An extensive set of data acquisition and data analysis programs were written. Elastic scattering events were separated from inelastic scattering events by line shape fitting. (Diss. Abstr.)

28812 SEARCH FOR GIANT MAGNETIC DIPOLE STATES IN ^{90}Zr AND ^{208}Pb. Cecil, F. E. Princeton, NH; Princeton Univ. (1972). 164p. University Microfilms Order No. 73-18,753.

Thesis (Ph. D.).

A search was conducted for giant magnetic dipole states in ^{90}Zr and ^{208}Pb using 24-MeV protons. No state in ^{90}Zr up to an excitation energy of 10.5 MeV or in ^{208}Pb in a region of excitation energy from 5.0 to 6.2 MeV was seen which allowed identification as 1+ on the basis of a preassigned set of criteria. An upper limit on the cross section for excitation by 24-MeV protons of the giant magnetic dipole state is determined to be 10 microbarns per steradian at forward scattering angles (35 to 45°) in the case of ^{90}Zr and 40 microbarns per steradian at a laboratory scattering angle of 25° in the case of ^{208}Pb. The differential cross section for excitation by 24-MeV protons of the ^{88}Sr 1+ state at 3.487 MeV was measured at laboratory scattering angles from 25 to 70°. This differential cross section was found to be significantly smaller than the cross section predicted in the distorted wave Born approximation assuming reasonable wave functions for the ^{88}Sr ground state and 1+ excited state, and assuming a Serber mixture for the nucleon–nucleon effective interaction. This measurement, together with the negative results of the search experiments in ^{90}Zr and ^{208}Pb are discussed with reference to the adequacy of describing the excitation of unnatural parity states in inelastic nucleon scattering by a purely central effective interaction. The 1- states in ^{90}Zr are identified at excitation energies 5.51, 5.89, and 6.42 MeV (±0.015 MeV). Levels in ^{208}Pb at 5.29, 5.51, and 5.94 MeV previously identified as 1- were seen in (p,p'). The levels at 5.29 and 5.51 MeV were also seen to be excited strongly in (α,α'). The properties of the observed 1- states in ^{90}Zr and ^{208}Pb are discussed with reference to the apparent absence of low lying collective electric dipole states in closed shell nuclei. (Diss. Abstr.)

28813 FAST NEUTRON CROSS-SECTIONS FOR ZIRCONIUM-90. Wilson, R. D. Charlottesville, VA; Univ. of Virginia (1973). 168p. University Microfilms Order No. 73-18,971.

Thesis (Ph. D.).

Neutron cross sections were measured in the MeV region for the isotope zirconium-90. These measurements include the total neutron cross section from 1.5 to 9.0-MeV, differential elastic and inelastic scattering cross sections for 2.91 MeV incident neutrons and for laboratory angles from 30 degrees to 145 degrees, inelastic differential scattering cross sections at 52 degrees for incident neutron energies from 2.7- to 4.5-MeV and neutron "evaporation" data for an incident neutron energy of 7.06 MeV. Calculations employing the optical and compound nuclear models were performed and the model parameters were varied systematically to provide the "best" overall agreement with both the total cross section data and the differential elastic and inelastic scattering data at 2.91 MeV. The results suggest an inadequacy in the Hauser–Feshbach–Moldauer compound nuclear model for inelastic scattering of neutrons from zirconium-90. The optical model calculations established that the imaginary well-depth is about one-half the value expected from global fits to elastic scattering data for a large number of nuclei. This is expected because zirconium-90 contains a closed shell of neutrons. Direct interactions were neglected in the analysis of inelastic scattering. Previous calculations estimate direct interaction contributions to be less than one percent for the levels resolved in these measurements. Nuclear temperature and level-density information were obtained from an analysis of the "evaporation" data. (Diss. Abstr.)

28814 EXCITATION FUNCTIONS FOR THE REACTIONS PRODUCING ^{121}I, ^{123}I, AND ^{124}I FROM IRRADIATION OF NATURAL ANTIMONY WITH ^{3}He AND ^{4}He PARTICLES WITH ENERGIES UP TO 30 MeV. Watson, I. A.; Waters, S. L.; Silvester, D. J. (Medical Research Council, London). J. Inorg. Nucl. Chem.; 35: No. 9, 3047-3053(Sep 1973).

Cross sections were determined experimentally for the ^{4}He reactions producing ^{123}I and ^{124}I and the ^{3}He reactions producing ^{121}I, ^{123}I, and ^{124}I, both from natural antimony. (auth)

28815 GENERALIZED OPTICAL MODEL POTENTIAL DERIVED FROM A SYSTEMATIC FAST NEUTRON ELASTIC SCATTERING STUDY. Holmqvist, B.; Wiedling, T. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Nucl. Energy; 27: No. 8, 543-551(Aug 1973).

Analytical descriptions of fast neutron elastic scattering cross sections and generalized optical model parameter sets have previously been presented on the basis of scattered experimental information. The present evaluation is founded on a relatively large set of neutron data. The neutron elastic scattering data collected for a number of elements and at several neutron energies were used in an attempt to get generalized analytical expressions for some parameters of the spherical optical model potential, i.e., the real and imaginary potential depths and the radii of these potentials. The experimental information is still too meagre in some atomic mass ranges to be used for such a purpose. The present work does not exclude future cross section measurements for several elements but it makes it possible to estimate cross sections for elements where experimental information is lacking. (auth)

28816 NUCLEAR MAGNETIC MOMENTS OF THE MOESSBAUER ISOTOPES ^{57}Fe AND ^{119}Sn. Brooks, J. S.; Williams, J. M.; Webster, P. J. (Univ. of Sheffield, Eng.). J. Phys., D (London); 6: No. 11, 1403-1408(19 Jul 1973).

A new and accurate determination of the magnetic moment of the 23.875 keV excited state of ^{119}Sn is presented. The mean value, $\mu_e = +(0.682 \pm 0.004)$ nm, obtained using two different absorbers, Co_2MnSn and Fe_3Sn, is in good agreement with previous measurements. The Heusler alloy Co_2MnSn is suggested as a suitable absorber to be used as a Moessbauer velocity calibration standard for ^{119}Sn, and the line positions are given at 4.2 K and 300 K. In addition some of the other published data relating to the nuclear moments of both ^{57}Fe and ^{119}Sn are clarified. (auth)

28817 PROJECTION OF THE N–NUCLEON COMPONENT FROM A ZERO, TWO-, AND FOUR-QUASI-PARTICLE STATE. The Case of ^{116}Sn. Bonsignori, G. (Univ., Bologna); Savoia, M. Lett. Nuovo Cim.; 8: No. 3, 182-184(15 Sep 1973).

Four-quasi-particle effects are included in a recently developed model where low lying states of superconductor nuclei are approximated by linear combinations of projected states. The case of ^{116}Sn for the 0^+, 2^+, and 4^+ states is presented. (JFP)

28818 NUCLEAR CHARGE DISTRIBUTION IN FISSION: FRACTIONAL INDEPENDENT YIELDS OF $^{139,140}Ba$ FROM THERMAL–NEUTRON INDUCED FISSION OF ^{233}U AND FRACTIONAL INDEPENDENT YIELDS OF ^{138}Cs FROM SPONTANEOUS FISSION OF ^{252}Cf AND THERMAL-NEUTRON INDUCED FISSION OF ^{249}Cf. Eichor, M. E. Columbia, MO; Univ. of Missouri (1972). 105p. University Microfilms Order No. 73-21,776.

Thesis (Ph. D.).

The fractional independent chain yields were measured for ^{139}Ba and ^{140}Ba from ^{233}U thermal-neutron induced fission. These values for ^{139}Ba and ^{140}Ba are 0.084 ± 0.007 and 0.27 ± 0.04, respectively. These yields were compared to similar measurements from ^{235}U thermal-neutron fission. These measurements indicate that nuclear-charge distribution for these chains is similar for both fission sources. The observation of an odd-even effect on the independent yield is pointed out. Finally, the similarities of charge distribution and isotopic yield distribution in fission of ^{233}U and ^{235}U are shown. The fractional independent chain yield of ^{138}Cs is measured from ^{249}Cf thermal-neutron induced fission and the spontaneous fission of ^{252}Cf. The yield from ^{249}Cf and ^{252}Cf is 0.37 ± 0.04 and 0.11 ± 0.03, respectively. Comparisons are made between ^{233}U, ^{235}U, ^{239}Pu, ^{249}Cf, and ^{252}Cf for this same measurement. For the two Cf isotopes it appears that the most probable charge may be closer to unchanged charge distribution than the corresponding Zp from ^{233}U, ^{235}U, or ^{239}Pu. Other measurements for these fissioning sources are pointed out where this same observation is noted. (Diss. Abstr.)

28819 SPIN ASSIGNMENTS OF LOW-LYING STATES IN ^{93}Nb. Sharma, H. C. (Kurukshetra Univ., India). p 33 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28820 NUCLEAR ACTIVATION CROSS SECTION, ISOMERIC RATIOS, AND SYSTEMATICS OF (n,p) REACTIONS AT 14.7 MeV. Tikku, V. K.; Singh, H.; Sethi, B. (Saha Inst. of Nuclear Physics, Calcutta). pp 115-117 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28821 TRENDS IN s- AND p-WAVE NEUTRON CAPTURE AT 25 keV. Rama Rao, J.; Siddappa, K.; Sriramachrandra Murty, M. (Andhra Univ., Waltair, India). p 119 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28822 EMPIRICAL BEHAVIOR OF THE (n,2n) CROSS SECTIONS FOR 14–15 MeV NEUTRONS. Garg, K. C.; Khurana, C. S. (Punjabi Univ., Patiala, India). p 123 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28823 CORE-EXCITATION EFFECTS IN ^{91}Nb SPECTRA. Shelly, S.; Bansal, R. K. (Panjab Univ., Chandigarh, India). pp 179-185 of Proceedings of the Nuclear Physics and Solid

State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28824 GROUND-STATE SPINS OF THE SPHERICAL ODD-ODD NUCLEI. Saini, S.; Gupta, S. K. (Bhabha Atomic Research Centre, Trombay, India). pp 255-256 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28825 LEVEL STRUCTURE OF ^{126}Te. Chaturvedi, S. N.; Prasad, R.; Ram, S. P.; Chaturvedi, L.; Nigam, A. K. (Banaras Hindu Univ., India). pp 367-370 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28826 NUCLEAR PENETRATION EFFECTS IN SOME PREDOMINANTLY MAGNETIC DIPOLE TRANSITIONS. Sahota, H. S. (Punjabi Univ., Patiala, India). pp 371-375 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28827 BETA-GAMMA DIRECTIONAL CORRELATIONS IN THE DECAY OF ^{122}Sb. Vema Reddy, B.; Priyadarsini, D. K.; Narasimha Raju, M. L.; Sastry, D. L. (Andhra Univ., Waltair, India). p 445 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28828 RELAXATION PHENOMENA IN THE GAMMA-GAMMA DIRECTIONAL CORRELATION IN A GASEOUS MEDIUM. Gycax, F. N. Diss. No. 4777. Zurich; Eidgenoessische Technische Hochschule (1971). 55p. (In French).

Thesis.

For the first time, the effect of buffer gas density on $\gamma-\gamma$ directional correlation was measured and interpreted for a wide density range. The following cascades, fed by electron capture decays of xenon isotopes, were experimentally studied for various pressure ranges of xenon buffer gas: 172 to 203 keV in ^{127}I (from 0.8 Torr to 57 atm), 145 to 58 keV in ^{127}I (from 0.8 Torr to 35 atm), 55 to 188 keV in ^{125}I (from 2 Torr to 16 atm). The 172 to 203 keV directional correlation in ^{127}I was also measured as a function of iodine buffer gas pressure between 0.25 and 48 Torr. A model describing the pressure dependence of the attenuation factor of an angular correlation, following electron capture, was developed. By fitting its predictions to the measurements, the following quantities were determined: The mean value of the cross section for charge exchange and electronic depolarization for collisions between highly ionized iodine atoms and xenon, $\bar{\sigma}_c(0) = (110^{+49}_{-35}) \cdot 10^{-15}$ cm^2, and iodine, $\bar{\sigma}_c(0) = (680^{+250}_{-210}) \cdot 10^{-15}$ cm^2, respectively. The mean value of the electronic depolarization cross section for iodine, following electron capture, in thermal equilibrium with xenon, $\bar{\sigma}_c = (6.1 \pm 0.9) \cdot 10^{-15}$ cm^2. The typical time for the strength of the hyperfine interaction of iodine, following electron capture, in thermal equilibrium with xenon, $\tau_{int} = 0.204 \pm 0.011$ ns for the 203 keV state of ^{127}I, and $\tau_{int} = 0.281 \pm 0.038$ ns for the 58 keV state. The directional correlation coefficient of the 172 to 203 keV cascade, $A_2 = 0.216 \pm 0.002$, which is believed to be close to the unperturbed value. The very large values of $\bar{\sigma}_c(0)$ are shown to be related to the polarization mechanism of the Langevin model. Some further angular correlation experiments are suggested. (auth)

28829 HALF-LIFE OF ^{129}I AND CROSS SECTION OF THE ^{129}I(n,2n)^{128}I REACTION FOR 14.5-MeV NEUTRONS. Kuhry, J. G.; Bontems, G. (Univ., Strasbourg). Radiochem. Radioanal. Lett.; 15: No. 1, 29-32(20 Sep 1973). (In French).

By measuring the absolute activity of ^{129}I samples with an organic liquid scintillator, a half-life of $1.97 \pm 0.14 \times 10^7$ years was found for the nuclide. A value of 1490 ± 190 mb was obtained for the cross section of the ^{129}I(n,2n)^{128}I reaction for 14.5-MeV neutrons. (auth)

28830 ROLE OF NUCLEAR MATRIX ELEMENTS IN NON-UNIQUE FORBIDDEN ELECTRON CAPTURE RATIOS. Vatai, E. (Georgia Inst. of Tech., Atlanta). Nucl. Phys., A212: No. 2, 413-423(1973).

The β-decay theory of Behrens and Bühring is used to investigate the role of nuclear matrix elements in electron capture (EC) ratios. The $(L_I + L_{II})/K$ and $(M_I + M_{II})/K$ ratios are found to be independent of the nuclear matrix elements, but EC ratios for shells with different $k = |\kappa|$ can be used to determine the nuclear matrix elements. The region of the decay energy where the L_{III}/K, M_{III}/L, and M_v/L ratios are large enough to be separated from the experimentally measured L/K or M/L ratios is determined. For three EC transitions, the ratio of nonrelativistic and relativistic nuclear matrix elements are estimated from experimental EC ratios. (auth)

28831 HIGH-SPIN STATES IN THE ISOTONES ^{89}Zr, ^{91}Mo, AND ^{93}Ru POPULATED IN α-PARTICLE-INDUCED REACTIONS. Nilsson, A.; Grecescu, M. (Research Inst. for Physics, Stockholm). Nucl. Phys., A212: No. 3 448-464(1973).

The reactions $(\alpha,3n\gamma)$ and $(\alpha,\alpha'n\gamma)$ on ^{88}Sr, ^{90}Zr and ^{92}Mo were used to populate excited states in ^{89}Zr, ^{91}Mo and ^{93}Ru. The deexcitation of these states was studied by in-beam γ-ray spectroscopy. The short-lived radioactivity of the ^{92}Mo target was measured in order to study the decay of ^{93}Ru. Many new levels were observed, particularly in ^{91}Mo. They are interpreted as due to the coupling of a $g_{9/2}$ neutron hole with known excited states in ^{90}Zr, ^{92}Mo and ^{94}Ru. (auth)

28832 HIGH-SPIN STATES IN THE N = 50 ISOTONES ^{91}Nb AND ^{93}Tc POPULATED IN $(\alpha,p2n\gamma)$ REACTIONS. Grecescu, M.; Nilsson, A.; Harms-Ringdahl, L. (Research Inst. for Physics, Stockholm). Nucl. Phys., A212: No. 3, 429-447(1973).

The reaction $(\alpha,p2n\gamma)$ on ^{90}Zr and ^{92}Mo targets was used to populate excited states in ^{91}Nb and ^{93}Tc, respectively. The deexcitation of these states was studied by in-beam γ-ray spectroscopy. The γ-ray transitions belonging to these nuclei were identified by studying coincidences with charged particles, excitation functions and $\gamma-\gamma$ coincidences. Angular distribution and lifetime measurements were also performed. Many new levels were observed, particularly in ^{93}Tc. They are interpreted in terms of shell-model calculations as belonging to the $(g_{9/2})^3$ and $(p_{1/2})\ (g_{9/2})^4$ proton configurations. (auth)

28833 STRONG L = 5 TRANSITION IN Te(p,p') REACTIONS. Matoba, M. (Kyushu Univ., Fukuoka); Hyakutake, M.; Niidome, J.; Yagi, K.; Aoki, Y.; Sato, K. Phys. Lett., 45B: No. 5, 463-464(20 Aug 1973).

Strong L = 5 transitions were found in the (p,p') reaction on ^{122,124,126,128,130}Te. The possible 2^5-pole collective motion in Te nuclei is discussed. (auth)

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Refer also to abstracts 28668, 28733, 28783, 28785, 28787, 28798, 28803, 28821, 28824, 28826, 28897, and 28957.

28834 (AED-CONF-71-400, pp 381-390) STUDIES ON TWO- AND THREE-QUASIPARTICLE STATES WHICH ARE PRODUCED THROUGH THE NUCLEAR PHOTO EFFECT IN DEFORMED NUCLEI RANGING FROM Z = 70 TO Z = 75. Schneider, U.; Collin, W.; Guldbakke, S.; Reich, H.; Witschel, W. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

For known two- and three-quasi-particle states with high spin, the transfer of angular momentum to the target nuclei is studied. Similar, yet unknown, states are analyzed with respect to the excitation energy, which yields information about the degree of pair interaction in different nuclei. Preliminary findings are reported. (6 figures, 2 tables) (HBG)

28835 EFFECTS OF NUCLEAR DEFORMATION ON NEUTRON TOTAL CROSS SECTIONS. Shamu, R. E.; Bernstein, E. M.; Blondin, D.; Ramirez, J. J.; Rochau, G. (Western Michigan Univ., Kalamazoo). Phys. Lett., 45B: No. 3, 241-243(23 Jul 1973).

Neutron total cross section differences were determined for ^{150,152,154}Sm from 0.8 to 15 MeV by measuring transmission ratios. Significant differences were observed for ^{152,150}Sm and for ^{154,150}Sm. Evidence is presented that these results can be attributed to nuclear deformation. (auth)

28836 EQUILIBRIUM DEFORMATIONS AND STRUCTURES OF A SERIES OF DEFORMED NUCLEI. Arsen'ev, D. A.; Pashkevich, V. V.; Solov'ev, V. G.; Fainer, U. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad, Nauk SSSR, Ser. Fiz.; 37: No. 5, 906-910(May 1973). (In Russian).

The parameters of the equilibrium deformations β^0_{20}, β^0_{40} for the ground states of even-even and odd nuclei in the range 174 ≤

$A \leq 185$ were calculated. The equilibrium deformations of a series of excited states of odd nuclei were also calculated. The effect on the energy and the structure of the nonrotational excited states of the change of the equilibrium deformation of these states was studied. It was shown that consideration of the effect $\beta^1 \neq \beta^0$ leads to better agreement with the experimental results of the calculated energy for the states p541↓, p532↓, p402↓, and n503↓. (7 tables) (tr-auth)

28837 EVIDENCE FOR ANOMALIES IN NUCLEAR MOMENTS OF INERTIA AT HIGH SPIN STATES. Mayer-Boericke, C. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft, Part B.: particle physics; Heidelberg, Germany (21 Feb 1973).

In the experimental investigation of the nuclear rotational states of very high spin, special emphasis has been placed on the study of anomalies in nuclear moments of inertia. Singles gamma spectra, $\gamma-\gamma$ coincidence spectra, and gamma spectra with reference to the accelerating pulses and the gamma angular distribution relative to the beam direction have been measured on the nuclei ^{158}Er, ^{160}Er, ^{164}Yb, ^{166}Yb, and ^{166}Hf. (13 figures) (GE)

28838 DECAY OF ^{169}Lu AND PROPERTIES OF THE LEVELS OF ^{169}Yb. Bonch-Osmolovskaya, N. A.; Gromov, K. Ya.; Islamov, T. A.; Khamidov, A. Sh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 972-988(May 1973). (In Russian).

The spectra of γ rays, positrons, and conversion electrons arising during the decay of ^{169}Lu were measured. On the basis of the extensive data obtained the level scheme of ^{169}Yb was analyzed. (2 figures, 6 tables) (tr-auth)

28839 INVESTIGATION OF THE DECAY OF ^{179}Re. Three-quasi-particle States in ^{179}W. Ari't, R.; Bayar, B.; Vylov, Ts.; Gromov, K. Ya.; Zaitseva, N. G.; Kamalkhodzhaev, Sh. M.; Muziol, C.; Novgorodov, A. F.; Usmanova, Z. A.; Fominykh, V. I.; Shtrusnyi, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 929-937(May 1973). (In Russian).

On the basis of the measurement of the γ spectrum of ^{179}Re and the $\gamma\gamma$ coincidence spectra, the level scheme of ^{179}W was substantially completed. The energy, relative intensity, and multipole order of the transitions, initiated through the decay of ^{179}Re, were measured and tabulated. The decay scheme of ^{179}Re is given. A comparison is made of the proposed levels of ^{179}W with the predictions of the microscopic theory. (1 figure, 3 tables) (JSR)

28840 EFFECT OF NUCLEAR DEFORMATION ON TOTAL NEUTRON CROSS SECTIONS. Dyumin, A. N.; Egorov, A. I.; Popova, G. N.; Smolin, V. A. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1019-1022 (May 1973). (In Russian).

The total neutron cross sections of ^{142,143,144,145,146,148,150}Nd, ^{144,148,149,150,152,154}Sm, and ^{154,155,156,157,160}Gd were measured in order to determine the effect of nuclear deformation on the cross section. The results showed a fairly strong dependence of the total cross section on the deformation parameter β_2. (2 figures) (JSR)

28841 RESONANCE SCATTERING OF γ QUANTA ON THE NUCLEUS ^{165}Ho. Kaipov, D. K.; Lysikov, Yu. A.; Shubnyi, Yu. K. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1095-1096(May 1973). (In Russian).

The lifetime of the 94.69-keV level of ^{165}Ho was measured by the method of resonance scattering, and a value of $\tau_\gamma = (1.36 \pm 0.24) \times 10^{-10}$ s was obtained. (2 figures) (tr-auth)

28842 INVESTIGATION OF THE NONSTATISTICAL EFFECTS IN THE SPECTRA OF γ RADIATION EMITTED DURING THE DECAY OF THE NEUTRON RESONANCES OF ^{147}Sm, ^{151}Gd, AND ^{177}Hf. Danelyan, L. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1129-1131(May 1973). (In Russian).

The intensities of the partial radiative transitions accompanying the decay of the neutron resonances in the (n,γ) reactions on ^{147}Sm, ^{151}Gd, and ^{177}Hf were measured. The study was made with the purpose of detecting the nonstatistical effects and of study of the structure of the highly excited states. In all three nuclei no correlation was detected between the probability of individual partial radiative transitions and the neutron widths shown. The partial radiative widths K_{E1} agree with the statistical model and the giant resonance model. (JSR) (2 tables)

28843 SPECTROSCOPIC INVESTIGATION OF SHORT-LIVED NEUTRON-DEFICIENT NUCLEI AT THE LINP SYNCHROCYCLOTRON OF THE ACADEMY OF SCIENCES, USSR. Berlovich, E. E.; Vaishnis, P. P.; Vitman, V. D.; Elkin, Yu. V.; Ignatenko, E. I.; Novikov, Yu. N.; Tarasov, V. K. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1052-1058(May 1973). (In Russian).

The method for the spectroscopic investigation of short-lived neutron-deficient nuclei was described in detail. Os and Re were studied. A γ line with $T_{1/2} = 1.4$ min was detected and assigned to the previously unknown isotope ^{178}Os, a γ line with $T_{1/2} = 45$ sec was assigned to ^{174}Os, and γ lines with $T_{1/2} \leq 20$ to 40 sec were assigned to ^{173}Os and ^{172}Os. A previously unknown isomeric state of ^{179}Os with a half-life of ~ 3 min was detected. In the study of Re, γ lines were detected with intensities which decay with the period $T_{1/2} = 2.2 \pm 0.2$ min and 0.6 ± 0.2 min. The first was assigned to ^{174}Re; and the second, to ^{172}Re or ^{173}Re. (5 figures) (JSR)

28844 EXCITATION OF THE 0^+ STATE IN TWO-NUCLEON-TRANSFER REACTIONS ON NUCLEI OF THE RARE EARTH REGION. Abdulvagabova, S. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1007-1015(May 1973). (In Russian).

The properties of the 0^+ excited states generated by pairing quadrupole, and spin-quadrupole interactions in nuclei of the rare earth region were investigated. The energies of the 0^+ excitation, probabilities of E0 and E2 transitions and their ratio (Rasmussen parameter X), as well as the spectroscopic factors for the excitation of the 0^+ state in two-nucleon-transfer reactions were calculated. (12 figures, 1 table) (tr-auth)

28845 NUCLEAR STRUCTURE OF ^{187}Os, ^{188}Os, AND ^{190}Os. Thompson, R. C. Tallahassee, FL; Florida State Univ. (1973). 195p. University Microfilms Order No. 73-21,360.

Thesis (Ph. D.).

The nuclei ^{187}Os, ^{188}Os, and ^{190}Os were studied with the reactions ^{186}Os(d,t)^{187}Os, ^{188}Os(d,t)^{189}Os, ^{189}Os(d,p)^{190}Os, and ^{189}Os(n,γ)^{190}Os. The deuteron-induced reactions were carried out at the Florida State University tandem Van de Graaff facilities. Deuteron-incident energies were 12 MeV for all reactions except one ^{186}Os(d,t)^{188}Os run at 14 MeV. The reaction products were analyzed in a broad-range magnetic spectrograph. The gamma rays following thermal neutron capture by ^{189}Os were detected by a Ge(Li) detector operated in conjunction with a NaI detector in both the coincidence and anticoincidence mode. In ^{187}Os, seventeen levels were observed with the ^{186}Os(d,t)^{187}Os reaction. In conjunction with previous decay work eighteen levels were incorporated in a level scheme. The $\frac{1}{2}^-$[510] ground band and $\frac{3}{2}^-$[512] band up to the $\frac{7}{2}^-$ levels were observed and were seen to be strongly coriolis coupled. The K-2 γ-band built on the $\frac{1}{2}^-$[510] band was observed and tentative assignments of the K+2 γ-band built on the $\frac{1}{2}^-$[510] and K-2 and K+2 γ-band built on the $\frac{3}{2}^-$[512] band were made. The $\frac{7}{2}^-$[503] level and the $\frac{13}{2}^+$ member of the $\frac{11}{2}^+$[615] band were found. Possible identification of the $\frac{7}{2}^-$[514] level was made. In ^{188}Os the 0^+, 2^+, and 4^+ of the ground state band and the 2^+, 3^+, and 4^+ levels of the γ-band were observed and mixing between these states was identified. Possible $K^\pi = 2^-$ and 3^- octupole bands were identified. The 0^+ state at 1087 keV was not populated by the (d,t) reaction. Thirty-seven states were observed by this reaction of which twenty-one have been previously unknown. In ^{190}Os thirty-two levels were observed by the ^{189}Os(d,p)^{190}Os reaction of which twenty-one have been previously unknown. The 2^+ member of the ground state rotational band and the 2^+, 3^+, and 5^+ members of the γ-band were observed. The 0^+ state at 912 keV appeared to have a rotational band built upon it of which the 2^+ member was populated by the (d,p) reaction. (Diss. Abstr.)

28846 DIRECTIONAL CORRELATION STUDIES IN ^{154,156}Gd AND THE LEVEL STRUCTURE OF ^{72}Se. Collins, W. E. Nashville; Vanderbilt Univ. (1972). 139p. University Microfilms Order No. 73-14,503.

Thesis (Ph. D.).

Gamma–gamma directional correlation studies were performed with a NaI(Tl)–Ge(Li) detector system on three transitions in ^{154}Gd, populated from the decay of ^{154}Eu. Large E2 components were found for the $4_3^+ - 4_2^+$ ($87 \pm 3\%$), $4_2^+ - 4_1^+$ ($94.4^{+1.2}_{-0.8}\%$), and the $2_3^+ - 4_2^+$ ($99.95^{+0.04}_{-0.07}\%$) transitions. Agreement between experimental and theoretical branching ratios is obtained for the 1048, 4_3^+ state if one assumes a large (≈50%) M1 component in the $4_3^+ - 4_2^+$ transition. Such a large M1 component is not observed. Thus, the branching ratios from this state are not in agreement with the theoretical predictions of the Bohr–Mottelson model for a β band. Gamma–gamma directional correlation studies with two Ge(Li) detectors were performed on transitions in ^{156}Gd, the levels of which were populated from the decay of ^{156}Eu. Seventeen correlations were measured including four one-three correlations. A $(12.6^{+1.4}_{-1.1}\%)$ E2 component measured in the 1169 keV, $2^{+\prime}$ transition from a $K^\pi = 0^+$ state at 1258 keV is in clear disagreement with the (≈67%) E2 component needed to bring the branching ratios into agreement with the Bohr–Mottelson model. It is suggested that the 1258 keV state is part of a $K^\pi = 0^+$ band that may be associated with quasi-particle excitations. The results for other one-two correlations are (E_γ, I_γ, % admixture): (1040, 2, E2 > 99.7), (1065, 2,

$E2 = 99.7^{+0.3}_{-0.3}$), (1154, 1, M2 = $0.01^{+0.08}_{-0.01}$), (1231, 2, M2 < 0.18), (1277, 1, M2 < 0.06), (1857, 1, $\sigma 1 > 92.7$), (1877, 1, $E2 = 9.3^{+2.5}_{-2.5}$), (1938, 1, $E2 = 28 \pm 2$), (2098, 1, $E2 = 68^{+9}_{-8}$), and (2181, 1, $E2 = 30^{+5}_{-4}$). For the one-three correlations one obtains (E_γ, $I_i - I$, % admixture): (812, 1-2, $0.57^{+0.42}_{-0.32}$ E2), (867, 1-2, 0.13 < M2 < 4.2), (944, 1-1, M2 < 6.3), and (970, 2.4, E2 > 98.6). The level structure of ^{72}Se, populated by the decay of ^{72}Br, was investigated. The ^{72}Br was produced in the ^{58}Ni(^{16}O,pn) reaction. Thirty transitions were assigned to ^{72}Se on the basis of half life, energy, and/or relative γ-ray yields for different beam energies. Sixteen transitions are confirmed by coincidence data. Twenty-nine transitions are placed into the decay scheme which consists of the following fourteen levels: 862.0,2^+; 936.8,0^+; 1316.7,2^+; 1638.8,4^+; 1876.0; 1998.4; 2150.3; 2371.6; 2433.2; 2586.2; 2965.6; 3124.1; 3225.9; and 3239.5. The low lying states in germanium, selenium, and krypton isotopes are compared. The behavior of the first excited 0^+ states in selenium and germanium is very similar for the same neutron number. (Diss. Abstr.)

28847 LOW LYING ENERGY LEVELS OF ODD MASS Ir ISOTOPES. Chandran, C. R.; Raju, M. L. N.; Satyanarayana, G.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Phys.; 56: No. 4, 251-255(Apr 1973).

An attempt is made to predict the energy levels in iridium-189, -191, and -193 on the basis of the core-excitation model. Such an attempt also helps to show the nature of the core–particle interaction. The results do not favor the odd proton being coupled to the 2+ state of the core. For comparison the levels are also predicted using the intermediate coupling model. Level diagrams are shown. (JFP)

28848 NUCLEAR QUADRUPOLE ALIGNMENT OF ^{180m}Hf AND ^{175}Hf IN HAFNIUM METAL. Kaindl, G.; Bacon, F.; Soinski, A. J. (Univ. of California, Berkeley). Phys. Lett.; 46B: No. 1, 62-64(3 Sep 1973).

^{180m}Hf and ^{175}Hf nuclei were aligned in the electric field gradient of single-crystal hafnium metal at temperatures down to 3mK. The temperature dependence of γ-ray anisotropies yielded the electric quadrupole interaction energies for ^{180m}Hf,$e^2qQ(8^-) = +(6.6 \pm 0.4) \times 10^{-18}$ erg, and for ^{175}Hf,$e^2qQ(5/2^-) = +(4.0 \pm 0.5) \times 10^{-18}$ erg, as well as the E2/M1 mixing ratio of the 343 keV γ-ray transition of ^{175}Lu, $\delta_{343} = -0.27 \pm 0.03$. (auth)

28849 SELF CONSISTENT CALCULATIONS OF A POSSIBLE SHAPE TRANSITION IN NEUTRON DEFICIENT MERCURY ISOTOPES. Cailliau, M. (Institut de Physique Nucleaire, Orsay, France); Letessier, J.; Flocard, H.; Quentin, P. Phys. Lett.; 46B: No. 1, 11-14(3 Sep 1973).

Deformation energy curves of some mercury isotopes are calculated within the constrained Hartree–Fock method using a Skyrme effective interaction. These static calculations indicate clearly the possibility of a prolate-oblate transition around ^{186}Hg which could be an explanation of the anomalous isotopic shift observed from ^{187}Hg to ^{185}Hg. The appearance of a very well defined secondary minimum, at large deformation ($\beta \sim 0.5$) for ^{200}Hg is also discussed. (auth)

28850 MAGNETIC MOMENT OF THE SECOND EXCITED STATE OF ^{160}Dy. Dhar, A. K.; Singh, B.; Hans, H. S. (Panjab Univ., Chandigarh, India). pp 343-347 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28851 INTERNAL-CONVERSION COEFFICIENTS OF THE 84.26-keV TRANSITION IN ^{170}Yb. Subba Rao, B. N. (Tata Inst. of Fundamental Research, Bombay). pp 385-391 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28852 LIFETIME OF THE 618-keV STATE IN ^{187}Re. Satyanarayana, G.; Rama Rao, M. T.; Lakshminarayana, V. (Andhra Univ., Waltair, India). pp 397-401 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28853 ELECTROMAGNETIC-TRANSITION PROBABILITIES IN ^{165}Ho. Patel, S. B.; Gopinathan, K. P. (Tata Inst. of Fundamental Research, Bombay). pp 451-455 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28854 PROPERTIES OF ROTATIONAL EXCITATIONS IN ^{159}Dy. Klamra, W.; Hjorth, S. A.; Rensfelt, K. G. (Research Inst. for Physics, Stockholm). Phys. Scr.; 7: No. 3, 117-124 (1973).

Cascade and cross-over transitions within the 3/2-[521] and 11/2-[505] bands as well as within a strongly perturbed band with positive parity are observed when high-spin levels in ^{159}Dy are populated in the ^{158}Gd(α,3n)^{159}Dy reaction. The rotational energies and the relative electromagnetic transition probabilities are discussed within the framework of the classical particle rotor model. The irregular struoture of the 3/2-[521] band and the positive-parity band can be reproduced to within 0.09 keV and 1.3 keV, respectively, in calculations where the theoretical Coriolis matrix elements are reduced. Furthermore, in these calculations the description of the relative transition probabilities in the positive-parity band is consistent with the calculations performed for ^{161}Dy only if the intraband M1 transitions with $\Delta K = 1$ are artificially reduced by the same amount as the matrix elements of the Coriolis force. (auth)

28855 NUCLEAR POTENTIAL-ENERGY SURFACE WITH INCLUSION OF AXIAL ASYMMETRY. Larsson, S. E. (Tekniska Hoegskolan, Lund, Sweden). Phys. Scr.; 8: No. 1-2, 17-31(1973).

The nuclear potential-energy surface was calculated on the basis of the modified oscillator model, including the degree of freedom of axial asymmetry. The regions investigated are the prolate-oblate transitional region around Os–Pt, the actinide region and the region of superheavy elements. The theoretical results indicate that the first barrier of the two-peak barrier in the actinides is reduced due to axial asymmetry, which leads to an improved agreement with empirical data. There also appears to be a modest reduction of the barrier for superheavy elements. (auth)

28856 SPREADING WIDTH OF ROTATIONAL DOORWAY STATES. Froebrich, P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin); Domcke, W. Phys. Lett. 45B: No. 5, 451-454 (20 Aug 1973).

The spreading width $\Gamma\downarrow$ for a special rotational doorway state in ^{159}Dy is calculated and found to be less than 32 keV. This means that an intermediate structure which originates from the doorway-continuum coupling (escape width $\Gamma\uparrow \approx 40$ keV) cannot be smeared out by the doorway-hallway coupling. (auth)

28857 SEMICLASSICAL DESCRIPTION OF HIGH SPIN STATES IN ROTATIONAL BANDS. Thieberger, P. (Brookhaven National Lab., Upton, NY). Phys. Lett., 45B: No. 5, 417-420(20 Aug 1973).

The potential energy term in a semiclassical expression for the level energy in nuclear rotational bands was replaced by a generic function of the moment of inertia and determined numerically from experimental data. The rather mild deviations of this function from a parabola are sufficient to account for recently discovered drastic changes of the moment of inertia with angular frequency. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 28655, 28660, 28662, 28668, 28697, 28717, 28729, 28754, 28785, 28787, 28793, 28812, 28821, 28824, 28826, 28845, 28847, 28849, 28855, 28886, 28903, 28905, and 28924.

28858 ALPHA-PARTICLE DECAY OF ^{218}Th, A NEW ISOTOPE. Hiruta, K.; Nomura, T.; Inamura, T.; Odera, M. (Inst. of Physical and Chemical Research, Wako-shi, Japan). Phys. Lett., 45B: No. 3, 244-246(23 Jul 1973).

A new isotope, $^{218}_{90}Th_{128}$, was found to decay with $E_\alpha = 9.67 \pm 0.02$ MeV and $t_{1/2} = 96 \pm 7$ ns. The reduced α-particle width of ^{218}Th is about 1.4 times the value expected from the general trend of the N = 128 isotones with Z = 84 to 89. (auth)

28859 TWO-NEUTRON PICKUP STRENGTHS ON THE EVEN LEAD ISOTOPES THE TRANSITION FROM SINGLE-PARTICLE TO COLLECTIVE. Lanford, W. A. (Michigan State Univ., East Lansing); McGrory, J. B. Phys. Lett., 45B: No. 3, 238-240(23 Jul 1973).

The (p,t) reaction on ^{208}Pb, ^{206}Pb, and ^{204}Pb was studied with 35-MeV protons. It is observed that the L = 0 ground-state cross section rapidly increases as one changes targets from ^{208}Pb to ^{206}Pb to ^{204}Pb while the cross section for other natural-parity transitions decreases. The observed cross sections are compared with predictions of the shell model and the pairing-vibration model. Both models are seen to describe some features of the data. (auth)

28860 1-FORBIDDEN $11_{1/2} \rightarrow 2g_{9/2}$; M1 TRANSITION IN ^{203}Pb. Haeusser, O.; Olin, A.; Witthuhn, W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Lett., 45B: No. 3, 247249(23 Jul 1973).

The mean lifetime of the 0.78 MeV first excited state in ^{209}Pb was measured by the recoil distance method to be τ_m = 11.8 ± 1.3 ps. The B(M1) for the l-forbidden transition is in good agreement with one of several recent theoretical predictions. (auth)

28861 EMISSION OF COMPLEX PARTICLES IN THE EXCITON MODEL. Ribansky, I.; Oblozinsky, P.; (Inst. of Physics, Bratislava, Czech.). Phys. Lett., 45B: No. 4, 318-320(6 Aug 1973).

The rate expression for the emission of complex particles derived by Cline was modified by taking into account all distinguishable configurations of excited nucleons from which a complex particle can be formed. This effect greatly improves the shape of the high energy portion of spectra and allows one to introduce the formation probability of complex particles. (auth)

28862 EFFECTS OF γ-INSTABILITY ON THE MUONIC X-RAYS OF ^{192}Os. Ikeda, A.; Ikeda, A.; Sheline, R. K. (Florida State Univ., Tallahassee). Phys. Lett., 45B: No. 3, 187-189 (23 Jul 1973).

Feasibility studies of the observation of effects arising from the transitional nature of ^{192}Os on its muonic x-rays are presented. Muonic K x-ray spectra are calculated, using E2 matrix elements from experiments and from Baranger-Kumar calculations. Experimentally observable energy shifts result from the nuclear γ-unstable nature of ^{192}Os. (auth)

28863 HEAVY-ION TRANSFER REACTIONS ON ^{208}Pb ABOVE THE COULOMB BARRIER. Anyas-Weiss, N.; Becker, J.; Belote, T. A.; Cornell, J. C.; Fisher, P. S.; Hudson, P. N.; Menchaca-Rocha, A.; Panagiotou, A. D.; Scott, D. K. (Nuclear Physics Lab., Oxford). Phys. Lett., 45B: No. 3, 231-234(23 Jul 1973).

The selective excitation of single-particle and hole states in stripping and pick-up reactions induced by ^{11}B ions of 113.5 MeV on ^{208}Pb is interpreted on the basis of a semi-classical theory. The excitations of outgoing ions and the continuum are also discussed. (auth)

28864 NUCLEAR MAGNETIC RESONANCE ON THE 10-, 0.88 ms STATE IN ^{206}Bi. Schaefer, G. (Univ., Bonn); Huebel, H.; Guenther, C.; Goldman, A.; Riegel, D. Phys. Lett.; 46B: No. 1, 65-66(3 Sep 1973).

The g-factor of the $\{\pi h_{9/2}, \nu i_{13/2}\}$ 10^- isomeric state in ^{206}Bi was measured by the method of in-beam NMR-PAC to be $|g| = 0.2631$ (24). The moment of the $i_{13/2}$ hole state, deduced to be −1.008(30) n.m., is discussed together with other known moments of $i_{13/2}$ neutron hole states. (auth)

28865 USE OF NONLOCALITY CORRECTIONS IN DWBA. Woods, T. J. (Univ. of Minnesota, Minneapolis). Phys. Lett.; 46B: No. 1, 41-43(3 Sep 1973).

It is argued that nonlocality effects of the distorted waves in a DWBA calculation should be used when one wishes to obtain the local equivalent form factor. The accounting for the nonlocality effects in the distorted waves depends strongly upon the shape of the form factor used but only weakly upon the Q-value of the reaction, with such effects being least noticeable for form factors which are strongly peaked at the nuclear surface, and most noticeable for form factors whose strength extends well beneath the nuclear surface. (auth)

28866 PROPERTIES OF IRIDIUM-193. Chandran, C. R.; Ramamurty, S. (Andhra Univ., Waltair, India). pp 187-190 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28867 SPECTRA, STATIC MOMENTS, AND TRANSITION PROBABILITIES IN ^{144}Pr AND ^{208}Bi. Sharma, S. D. (Panjabi Univ., Patiala, India). pp 241-245 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28868 INNER BREMSSTRAHLUNG FROM ^{204}Tl. Prasad Babu, R.; Narayana, D. G. S.; Sarma, K. V. N. (Andhra Univ., Waltair, India). pp 411-415 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28869 ELECTRON SHAKE-OFF IN BETA DECAY OF ^{210}Bi AND ^{204}Tl. Pathak, B. P. (Saha Inst. of Nuclear Physics, Calcutta). pp 417-423 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28870 INFLUENCE OF THE CONTINUUM ON LEVEL-DENSITIES. Mosel, U. (Univ., Giessen, Ger.). Phys. Lett., 46B: No. 1, 8-10(3 Sep 1973).

The influence of the continuum on microscopic calculations of nuclear level densities is investigated by comparing two different approaches, one that discretizes the continuum and one that determines the state density there from the scattering phases. Whereas the connection between excitation energy and nuclear temperatures can be changed drastically the level density turns out to be less sensitive to the treatment of the continuum. (auth)

28871 HIGH SPIN THREE NEUTRON HOLE STATES IN ^{205}Pb OF CONFIGURATIONS CONTAINING THE $i_{13/2}$ ORBITAL. Bergstroem, I.; Blomqvist, J.; Filevich, A.; Linden, C. G. (Research Inst. for Physics, Stockholm). Phys. Scr.; 8: No. 1-2, 5-13(1973).

A new $25/2^-$ isomeric state at 3 195 keV with a half-life of 226 ± 17 ns was found in ^{205}Pb, using the ^{204}Hg (α,3n) reaction. The $25/2^-$ state is suggested to decay to a $21/2^-$ state by a 27.7 keV (E2) transition and to a $19/2^+$ state by a 1 175.1 keV (E3) transition. A cascade of two γ-rays of energies 323.2 keV (M1) and 683.5 keV (E2) connects the $19/2^+$ state with the previously known 4 ms $13/2^+$ isomeric state at 1 013.7 keV. The new levels seen in the decay of the $25/2^-$ state are likely to be due to configurations involving one or two $i_{13/2}$ neutron holes and can be predicted rather accurately by using empirical interaction matrix elements from ^{206}Pb. Assuming that the $25/2^-$ state has a pure $i_{13/2}^{-2}p_{1/2}^{-1}$ configuration an effective $i_{13/2}$ neutron quadrupole charge of 1.30 ± 0.11 units is found. Allowing for configurational mixing leads to an effective charge of 0.94 ± 0.08 in good agreement with the corresponding transition $(i_{13/2})_{12+}^{-2}$ $(i_{13/2})_{10+}^{-2}$ in ^{206}Pb. Both these transitions give supporting evidence for the coupling of the $i_{13/2}$ neutron hole to the isoscalar and isovector giant quadrupole modes of the ^{208}Pb core. Some evidence for the expected $(i_{13/2})_{33}^{-2}{}_{/2+,29/2+}$ and $(i_{13/2})^{-2}(f_{5/2})_{29/2-}^{-1}$ levels is found. (auth)

28872 DECAY OF ^{210}Rn TO LEVELS IN ^{210}At. Jonson, B. (CERN, Geneva); Alpsten, M.; Appelqvist, A.; Berngtsson, B.; Johansson, K. A. Phys. Scr.; 7: No. 4, 147-159(1973).

The decay of ^{210}Rn to ^{210}At was investigated. Gamma rays were recorded in singles and coincidence using Ge(Li) detectors. Conversion electrons were studied with a Si(Li) detector and a double focussing magnetic spectrometer. Internal conversion coefficients were deduced, and several transition multipolarities were determined. A decay scheme is presented and spin assignments are made. (auth)

28873 DENSITY REARRANGEMENT EFFECTS AND SINGLE-PARTICLE ENERGIES IN NUCLEI. Cusson, R. Y.; Kolb, D.; Trivedi, H. P. (Duke Univ., Durham, NC). Lett. Nuovo Cim.; 7: No. 16, 793-796(18 Aug 1973).

Using lead-208 as an example the influence of the removal or addition time on the observed values of the single-particle (hole) energies in a nucleus is investigated. This is done by postulating the existence of a density rearrangement effect related to both the removal time and the strength of the interactions. (JFP)

28874 M2 ISOMERISM IN THE N = 123 ISOTONES. Conlon, T. W. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A212: No. 3, 531-540(1973).

A new isomer with a half-life of 1.0 ms which decays primarily by an M2 transition with an energy of 229.4 keV was observed and assigned to the nucleus ^{206}Bi. The isomer has similar characteristics to the known M2 isomers in ^{205}Pb and ^{207}Po which are isotones (N = 123) of ^{206}Bi. The isomeric decay of ^{207m}Po(50 μs) was also investigated. (auth)

28875 GAMMA-RAY MULTIPOLARITY STUDIES BY THE NUCLEAR ORIENTATION OF ^{206}Bi IN NICKEL: PERTURBATION IN THE 120 μs 2.2 MeV STATE OF ^{206}Pb. Kaplan, M.; Johnston, P. D.; Kittel, P.; Stone, N. J. (Oxford Univ.). Nucl. Phys., A212: No. 3, 478-492(1973).

Measurements of the anisotropic γ-ray distribution from the decay of ^{206}Bi nuclei oriented in the hyperfine field of a nickel host were used to determine the E2 admixture into six predominantly M1 transitions in ^{206}Pb. The γ-ray distribution shown by the 516 keV transition is shown to differ from that expected for the E3 transition. This is analyzed in terms of a perturbation of the intermediate state eigenfunctions by an off-axis electric quadrupole interaction. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 28785, 28818, 28824, 28826, 28855, 28870, 28924, and 29250.

28876 (AED-CONF-71-400, pp 49-61) INTERMEDIATE STRUCTURE IN FISSION CROSS SECTIONS. Paya, D. (CEN de Saclay, Gif-sur-Yvette, France). 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Published results on the intermediate structure in fission cross sections are discussed, and most of the ideas are illustrated with data on ^{237}Np. Evidence is given that the intermediate structure does not come from the neutron entrance channel, but rather is due to the coupling of the compound-nucleus states to the fission exit channels; this coupling is more intense at some definite energies, namely, those at which the observed fission resonances cluster. The double-humped fission barrier plays an important role in the interpretation of this phenomenon. The fission widths of ^{237}Np divide into two groups, and one can deduce that the 2^+ resonances have a large width while the 3^+ resonances have a small width. Fission widths of 1^+ resonances in ^{239}Pu averaged over 110-eV intervals are plotted, and their energy dependence shows rather extensive variations that are incompatible with a conventional statistical model. (6 figures) (RWR)

28877 (AED-CONF-71-400, pp 109-117) NUCLEAR FISSION THROUGH RESONANCE NEUTRONS. Theobald, J. P. (EURATOM, Geel, Belgium). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

For physicists of very different specialties, both the techniques and the findings on neutron time-of-flight spectroscopic measurements are presented. The measurements study nuclear fission. Problems of data evaluation and interpretation are discussed. Special emphasis is placed on subthreshold fission. (tr-auth)

28878 (INR-1444) OCTUPOLE VIBRATIONAL LEVELS OF ^{228}Th, ^{230}Th, ^{230}U, AND ^{232}U. Kurcewicz, W. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 81p. (In Polish). Dep. NTIS (U. S. Sales Only) $6.25.

The decay schemes of ^{228}Pa → ^{228}Th, ^{230}Pa → ^{230}Th, ^{230}U, and ^{232}Pa → ^{232}U were studied using magnetic and semiconductor (Ge/Li/ and Si/Li/) spectrometers. Single spectra of γ rays, spectra of internal-conversion electrons and spectra of β-γ, e-γ, and γ-γ coincidences were measured. The ^{228}Pa → ^{228}Th, ^{230}Pa → ^{230}Th, and ^{232}Pa → ^{232}U decay energies were determined. The schemes of the ^{228}Th, ^{230}Th, ^{230}U, and ^{232}U energy levels were constructed. In particular new experimental data on octupole bands were obtained and compared with the results of the microscopic model calculations. The Coriolis mixing of these bands was studied. (auth)

28879 (LA-UR-73-1179) EXPERIMENTAL FISSION BARRIERS FOR ACTINIDE NUCLEI. Back, B. B.; Britt, H. C.; Garrett, J. D.; Hansen, O.; Lerous, B. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 31p. (CONF-730823-18; SM-174/201). Dep. NTIS $3.75.

From third symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Fission probability distributions are measured for a number of isotopes of Th, Pa, U, Np, Pu, Am, Cm and Bk using (d,pf), (t,pf), (^{3}He,df), (p,p'f), (^{3}He,αf) and (t,αf) reactions. The results along with previous data available from (d,pf) and (n,f) studies are analyzed with a statistical model and estimates are obtained for the heights, E_A and E_B, and curvatures, $\hbar\omega_A$ and $\hbar\omega_B$, of the two peaks of the fission barrier for a wide range of actinide nuclei. The statistical model used for the analysis of odd A and odd-odd nuclei includes competition between fission, neutron emission and gamma ray de-excitation in the decay of the compound nucleus. The results suggest that fission widths which are greater by about a factor of 4 than those calculated are necessary to reproduce the magnitude of the measured fission probabilities. The results show that E_A is roughly constant throughout this region and E_B decreases with increasing Z. An exception to the approximate constancy of E_A is in Cm where E_A drops by 1.0 MeV from ^{248}Cm to ^{250}Cm. In some cases an odd-even fluctuation of 0.30 to 0.50 MeV is observed in the experimental E_A values. (auth)

28880 CROSS SECTION AND ANISOTROPY OF URANIUM-235. Ivanov, K. N.; Solov'ev, Yu. A.; Petrzhak, K. A. (JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 429-431(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 610-612(5 Jun 1973).

The intermediate structure in the fission cross section for gamma energies of 5 to 12 MeV and the anisotropy at values of the maximum energy from 6 to 15 MeV were investigated. The photofission yield, cross section, fission fragment angular distribution, and anisotropy as a function of maximum gamma energy were found. (JFP)

28881 INFLUENCE OF THE DOUBLE BARRIER ON THE QUADRUPOLE ABSORPTION COMPONENT OF PHOTOFISSION. Vandenbosch, R. (Univ. of Washington, Seattle). Phys. Lett., 45B: No. 3, 207-210(23 Jul 1973).

The dominance of the quadrupole component in near-threshold photofission of ^{240}Pu and its near absence in ^{232}Th is shown to follow naturally from the properties of the doublehumped fission barriers. (auth)

28882 NEUTRON CAPTURE CROSS-SECTION MEASUREMENTS FOR ^{238}U AND ^{115}In BETWEEN 150 AND 630 keV. Ryves, T. B.; Hunt, J. B.; Robertson, J. C. (National Physical Lab., Teddington, Eng.). J. Nucl. Energy; 27: No. 8, 519-529(Aug 1973).

The ^{238}U(n,γ)^{239}U and ^{115}In(n,γ)^{116m}In neutron capture cross sections were measured by the activation technique for several neutron energies between 150 and 630 keV. The neutron flux was measured with a calibrated long counter. The errors on the results at a confidence level of approximately 99% were about ±7% for U and ±4% for In, with standard deviations of ±2%. (auth)

28883 FISSION NEUTRON SPECTRUM OF ^{235}U. Wood, J. (Queen Mary Coll., London). J. Nucl. Energy; 27: No. 8, 591-595(Aug 1973).

By means of a computer program which incorporates the Marquardt algorithm the data of Cranberg and others, who measured the emitted neutrons over the energy range 0.18 to 13 MeV for ^{235}U, were refitted to the semi empirical Watt type expression for prompt neutrons released with energy E, $N(E) = a_1 e^{-a_2 E}$ (sinh $a_3\sqrt{E}$) where E is in MeV, and also to the simple theoretical derivation $N(E) = b_1\sqrt{E}e^{-b_2 E}$. Results are compared and discussed in each case with the earlier data. Other measurements of the fission spectrum were combined and fitted to these equations. Comparison of differential and integral spectra shows that the data adjustment technique predicts a harder fission spectrum. The inclusion of additional terms into the standard expressions did not appear justified. (UK)

28884 SYMMETRIC AND ASYMMETRIC FISSION OF Ac ISOTOPES NEAR THE FISSION THRESHOLD. Konecny, E. (Univ., Munich); Specht, H. J.; Weber, J. Phys. Lett., 45B: No. 4, 329-331(6 Aug 1973).

Fission and fragment anisotropies were investigated for fission of ^{227}Ac and ^{228}Ac by means of direct reactions with a ^{3}He beam on a ^{226}Ra target. Triple-humped mass distributions are found also for excitation energies where second-chance fission is excluded. The fission barrier is higher for symmetric fission compared to that for asymmetric fission by 1.2 and 2.0 MeV, respectively, suggesting that the character of the mass split is already predetermined at the saddle point. (auth)

28885 NONROTATIONAL STATES OF A SERIES OF NUCLEI OF TRANSCURIUM ELEMENTS. Ivanova, S. P.; Komov, A. L.; Malov, L. A.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 911-921(May 1973). (In Russian).

Theoretical studies were made of the low nonrotational states of the deformed nuclei in the range $250 \le A \le 261$. The parameters of the model used, based on analogous studies for nuclei in the range $234 \le A \le 250$ and also rare earth elements in the range $150 \le A \le 190$, were reported in detail. The energy and structure of the ground and excited states were tabulated for ^{251}Cf, ^{253}Cf, ^{253}Fm, ^{257}Fm, ^{255}102, ^{257}102, ^{261}Ku, ^{251}Es, ^{257}Md, and ^{257}103. (2 figures, 12 tables) (JSR)

28886 BINDING ENERGIES AND STABILITY OF HEAVY NUCLEI. Kolesnikov, N. N.; Selinov, I. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1102-1106(May 1973). (In Russian).

The property of the energy surface of heavy nuclei and the connection between half-life and energy of α and β decay and fission were investigated in detail. An attempt was made to extrapolate the formulas found to the area of superheavy nuclei. (3 figures) (JSR)

28887 SIMULTANEOUS MEASUREMENTS OF THE NEUTRON FISSION AND CAPTURE CROSS SECTIONS FOR URANIUM-235 FOR NEUTRON ENERGIES FROM 8 eV TO 10 keV. Perez, R. B.; de Saussure, G.; Silver, E. G.; Ingle, R. W.; Weaver, H. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 52: No. 1, 46-72(Sep 1973).

Simultaneous measurements of the neutron fission and capture cross sections of ^{235}U were performed at the Oak Ridge Electron Linear Accelerator for neutrons with energies between 8 eV and 10 keV. These cross sections were measured relative to the shape of the standard ^{10}B(n,α) reaction cross section, and normalized to the Oak Ridge National Laboratory–Rensselaer Polytechnic Institute data between 100 and 200 eV. The comparison of the present ^{235}U capture cross section with the values from other available sources shows that below 200 eV there is general agreement within an error band of ±5%. In the keV energy region, the average dif-

ference observed rises to ±12%. The fission cross section results presented agree with a worldwide compilation of fission data typically within a 3% error in the entire range of neutron energies investigated. The values of alpha, capture-to-fission ratio, exhibit a remarkable amount of structure. (auth)

28888 YIELDS OF LOW-MASS PRODUCTS IN THE FISSION OF ^{232}Th BY 14.8 MeV NEUTRONS. Battles, L. R.; Chittenden, D. M. (Arkansas State Univ., Jonesboro). J. Inorg. Nucl. Chem.; 35: No. 9, 3075-3078(Sep 1973).

The products from the 14.8-MeV neutron induced fission of ^{232}Th for the five mass chains, A = 66, 67, 72, 73, 77, were radiochemically determined. The absolute activities were determined from decay curves, and cumulative fission yields were measured relative to ^{99}Mo. These data were used to investigate two of the unusual pairs of independent-fractional yields in the mass region A = 72 to 78. These fission yields were also compared to corresponding mirror points, assuming 4.5 secondary neutrons emitted per fission of ^{232}Th. (auth)

28889 MASS-YIELD VARIATIONS IN THE THERMAL AND EPITHERMAL FISSIONS OF ^{239}Pu. Tong, S. L.; Fritze, K.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). J. Inorg. Nucl. Chem.; 35: No. 9, 3079-3086(Sep 1973).

Mass-yield ratios of ^{77}Ge and ^{77}As from thermal and epi-Cd fissions, and of ^{77}Ge and ^{166}Dy–^{166}Ho from thermal and epi-Sm fissions of ^{239}Pu were measured radiochemically. It was found that the epi-thermal fission yield of the 77-mass chain showed only a slight decrease, if any, compared with fission caused by thermal neutrons, while the epi-Sm fission yield of ^{166}Dy–^{166}Ho was found to be lowered by 30%. The Ge(Li) γ-ray spectroscopic measurements confirmed previous results that no significant fluctuations in the mass-yield ratios of ^{85m}Kr, ^{91}Sr–^{91m}Y, ^{92}Sr, ^{97}Nb–^{97}Zr, ^{99m}Tc, ^{103}Ru, ^{105}Ru, ^{131}I, ^{132}Te–^{132}I, ^{133}I, ^{135}I–^{135}Xe, ^{140}Ba–^{140}La, ^{143}Ce and ^{147}Nd for both thermal to epi-Cd and thermal to epi-Sm fission of ^{239}Pu were observed. These results, combined with the previous data on ^{72}Zn, ^{112}Pd, and ^{115}Cd, are consistent with theoretical proposals that suggest the existence of a symmetric and an asymmetric mode of fission. (auth)

28890 HEAVY ISOTOPES OF ACTINIUM: ^{229}Ac, ^{230}Ac, ^{231}Ac and ^{232}Ac. Chayawattanangkur, K.; Herrmann, G.; Trautmann, N. (Univ., Mainz). J. Inorg. Nucl. Chem.; 35: No. 9, 3061-3073(Sep 1973).

By irradiation of ^{232}Th with 150-MeV bremsstrahlung and with 14-MeV neutrons, three new neutron-rich isotopes of actinium, ^{230}Ac, ^{231}Ac, and ^{232}Ac, were produced and identified and the previously reported isotope, ^{229}Ac, was confirmed. The actinium isotopes were chemically isolated by a fast procedure based on elution with α-hydroxyisobutyric acid from cation exchange resins. For ^{229}Ac, a half-life of 62.7 ± 0.5 min and a β-ray energy of 1.14 ± 0.15 MeV were found; 35 γ-rays were observed, the strongest ones with the following energies and relative intensities: 135.3(34), 146.4(35), 164.6(100), 252.2(24), 261.9(39), 317.0(23), 539.9(20), 569.1(91), and 605.2 keV(23). For ^{230}Ac, a half-life of 80 ± 10 sec and γ-rays of 454.5(100) and 508.1 keV(58) were obtained. ^{231}Ac was found to decay with a half-life of 7.5 ± 0.1 min. A total of 22 γ-rays were detected with the strongest ones at 185.6(43), 221.2(49), 240.6(11), 282.3(100), 306.9(77) and 368.8 keV(38). For ^{232}Ac, a half-life of 35 ± 5 sec was obtained. (auth)

28891 EPR DETERMINATION OF THE NUCLEAR SPINS AND MAGNETIC MOMENTS OF ^{243}Cm AND ^{247}Cm. Abraham, M. M.; Boatner, L. A.; Finch, C. B.; Reynolds, R. W.; Unruh, W. P. (Oak Ridge National Lab., TN). Phys. Lett.; 44A: No. 7, 527-528 (13 Aug 1973).

EPR spectroscopy was employed in making the first direct measurements of the nuclear spins of ^{243}Cm and ^{247}Cm (I = 5/2 and I = 9/2 respectively). Estimated nuclear moments are $|0.4\ \mu_N|$ for ^{243}Cm and $|0.36\ \mu_N|$ for ^{247}Cm. (auth)

28892 PROTON INDUCED FISSION CROSS SECTIONS OF THE URANIUM ISOTOPES ^{233}U, ^{234}U, ^{235}U, ^{236}U, AND ^{238}U. Boyce, J. R. Durham, NC; Duke Univ. (1972). 127p. University Microfilms Order No. 73-19,465.

Thesis (Ph. D.).

The Cyclo-Graaff facility at Triangle Universities Nuclear Laboratory located on the Duke University campus was used to measure proton induced total fission cross sections for the uranium isotopes ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U. The 90° differential cross sections were measured for the incident proton energy range $4.5 \leq E_p \leq 31.0$ MeV in 250 keV and smaller energy steps with a maximum beam-energy spread of 5 keV at 30 MeV. In addition over 100 fission fragment angular distributions were measured at angular intervals of 10° between 20 and 160° and were analyzed to determine fission fragment anisotropies as a function of excitation energy. The angular distribution results were combined with the 90° differential cross sections to obtain accurate proton induced total fission cross sections. Targets used were supplied by Oak Ridge National Laboratory and were of isotopic purity greater than 99%. Surface barrier fission fragment counters were used to detect fission fragments. A method of analysis was developed and demonstrated whereby first, second, and third chance fission contributions to the total yield are estimated. The method utilizes the optical model to describe the formation of the compound system and a statistical formalism to describe the de-excitation of the excited compound nucleus in either fission or neutron channels as the dominant decay mechanism. The analysis of cross section ratios for different isotopes clearly indicates that conventional optical models overestimate the proton total reaction cross section for incident proton energies below the Coulomb barrier. An empirically adjusted reaction cross section is therefore used for the compound nucleus formation cross section used in the calculations. The sensitivity of the analysis to various assumptions and model parameters is discussed. The analysis of the measured cross section data results in the determination of previously unreported fission thresholds and the energy dependence of neutron to fission branching ratios, Γ_m/Γ_f, for all isotopes studied. The formulation is general enough to allow incorporation of refinements based on the current state of nuclear theory. (Diss. Abstr.)

28893 FISSION PRODUCT MASS-YIELD MEASUREMENTS FROM INTERMEDIATE ENERGY NEUTRON FISSION OF PLUTONIUM-239 AND PLUTONIUM-241. Anderson, D. G. Austin, TX; Univ. of Texas (1972). 134p. University Microfilms Order No. 73-18,394.

Thesis (Ph. D.).

Ten fission product yield fractions from thermal and intermediate energy neutron induced fission of plutonium-239 and plutonium-241 were determined. The thermal neutron induced yield fractions of plutonium-239 and plutonium-241 were measured and compared with previous measurements in order to establish confidence in experimental and computational techniques. Subsequently the thermal neutron spectrum from the Texas A&M University Nuclear Science Center Reactor was tailored to an intermediate spectrum by the insertion of both boron filters and photoneutron sources. The yield fractions of plutonium-239 and plutonium-241 were then determined using this photoneutron and absorption hardened neutron spectrum. The yield values for plutonium-239 were compared to previous thermal and epithermal neutron spectrum measurements in order to validate the experimental procedure for the initial measurements of plutonium-241. The neutron spectrum from the reactor was determined using foil activation techniques and the SAND II computer code. The gamma spectra from the fission products of plutonium (239 and 241) were analyzed using a Ge(Li) detector—gamma spectrometer system. (Diss. Abstr.)

28894 EVIDENCE FOR SIMULTANEOUS EMISSION OF TWO LIGHT CHARGED PARTICLES IN THERMAL-NEUTRON FISSION OF ^{235}U. Kapoor, S. S.; Choudhury, R. K.; Kataria, S. K.; Murthy, S. R. S.; Ramamurthy, V. S. (Bhabha Atomic Research Centre, Trombay, India). pp 107-113 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28895 HAUSER–FESHBACH CALCULATIONS ON ^{235}U. Satyanarayana, U. (Andhra Univ., Waltair, India); Ramamurty, S.; Garg, S. B. p 213 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28896 ELECTROMAGNETIC PROPERTIES OF THE 285.5-keV LEVEL IN ^{239}Pu. Patel, S. B.; Agnihotry, A. P.; Gopinathan, K. P.; Tandon, P. N. (Tata Inst. of Fundamental Research, Bombay). pp 459-462 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28897 NEW APPROACH TO DEFORMATION ENERGY CALCULATIONS. Ko, C. M.; Pauli, H. C.; Brack, M.; Brown, G. E. (State Univ. of New York, Stony Brook). Phys. Lett., 45B: No. 5, 433-436(20 Aug 1973).

A simplified microscopic method is used to calculate the deformation energy curves of heavy nuclei, which show a second minimum and two fission barriers at about the same deformations as in the shell-correction calculations. (auth)

28898 RATIO OF THE TERNARY TO BINARY FISSION INDUCED BY THERMAL AND RESONANCE NEUTRONS IN ^{239}Pu.

Wagemans, C. (SCK/CEN, Mol, Belg.); Deruytter, A. J. Nucl. Phys., A212: No. 3, 556-572(1973).

Measurements were performed of the ratio of ternary to binary fission (T/B) in ^{239}Pu by neutrons in the energy region from 0.020 to 50 eV. The ternary and binary fission time-of-flight spectra were recorded at a 8.1 m flightpath at the Geel Linac with large gold-silicon surface-barrier detectors on both sides of a 1 mg/cm^2 double-faced ^{239}Pu target. From these time-of-flight spectra the ratios of the areas of the strongest isolated resonances in ternary and in binary fission were calculated; moreover in the region 0.02 to 1 eV ratios were calculated for about 40 zones throughout the spectrum. The T/B ratio does not vary significantly in the energy region below 1 eV; this is not the case in the region 1 to 50 eV, where the T/B value for the 15.5 eV resonance is significantly larger than for the other resonances. These T/B values seem to be correlated with the resonance spin J and with some other fission characteristics. (auth)

28899 PHOTOFISSION CROSS SECTIONS OF ^{238}U AND ^{235}U FROM 5.0 TO 8.0 MeV. Anderl, R. A.; Yester, M. V.; Morrison, R. C. (Ames Lab., IA). Nucl. Phys., A212: No. 2, 221-240(1973).

Cross sections extracted from measured yield curves are reported for photofission of ^{238}U and ^{235}U. Surface barrier detectors were used to measure the fission yields from metal foil targets of ^{238}U (enriched to 99.97%) and ^{235}U (enriched to 97.68%) for maximum photon energies stepped from 5.0 MeV to 8.0 MeV in 0.1 MeV increments. The photons were obtained by Compton scattering γ-rays produced by neutron capture in a nickel plate near the core of the 5 MW Ames Laboratory Research Reactor. An unfolding procedure was used to extract the smoothed cross sections from the measured yield curves. In the ^{238}U(γ,f) cross section, prominent structure is observed at 6.2 MeV and 7.6 MeV with hints of structure at 5.5 MeV and 7.0 MeV. The ^{235}U(γ,f) cross section shows pronounced structure at 5.9 MeV, 6.6 MeV and 7.5 MeV with a hint of structure at 5.4 MeV. These cross sections are compared to previous photofission measurements and are discussed in the framework of Bohr's "fission channel" theory. (auth)

28900 PROMPT NEUTRONS FROM FISSION. Skarsvaag, K. (Institutt for Atomenergie, Kjeller, Norway). Phys. Scr.; 7: No. 4, 160-164(1973).

Experimental data for the velocity (or energy) and angular distributions of prompt neutrons from fission were reanalyzed within the framework of the equilibrium statistical model. The model is tested on data for the spontaneous fission of ^{252}Cf and for slow neutron fission of ^{235}U. It is concluded that the deviation from the hypothesis of neutron emission from fully accelerated fragments to a large extent is due to neutron evaporation in the acceleration period of the fragments. No convincing evidence for scission neutrons was found. (auth)

Nuclear Theory

Refer also to abstracts 27941, 28271, 28344, 28494, 28786, 28886, and 29113.

28901 (AED-CONF-71-400, pp 1-19) STUDIES OF NUCLEAR STRUCTURE WITH PHOTONS AND ELECTRONS IN THE MEDIUM ENERGY RANGE. Weise, W. (Univ., Erlangen Nuernberg, Ger.). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

The absorption of real and virtual photons by nuclei in the energy range above giant resonances is discussed. The experimental findings are interpreted by means of the usual models for nuclei. The interpretation shows that a short-range correlation between bound nucleons must be introduced. This introduction leads to a significant improvement in the description of the following reactions: (γ,pn), (γ,p), (γ,n), (e,e), and (e,e'p). (16 figures) (HBG)

28902 (AED-CONF-71-400, pp 39-48) THEORIES OF PHOTOFISSION AND ELECTROFISSION. Drechsel, D. (Univ., Mainz). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

With the success of the two-center shell model for description of the nuclear fission process, a dynamic description of both photofission and electrofission becomes nearer. The presently available mathematical arrangements for such a description are reviewed. (6 figures) (tr-auth)

28903 (AED-CONF-71-400, pp 147-160) REPORT ON A MODEL-INDEPENDENT EVALUATION PROCEDURE FOR ELASTIC ELECTRON SCATTERING EXPERIMENTS. Merle, K. (Univ., Mainz). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

Elastic electron scattering data usually are evaluated by means of an analytical 3-parameter Fermi distribution. An evaluation that is independent of models can be obtained through the Lenz delta-function charge distributions. The procedure yields characteristic nuclear data, as well as their range of error, which are free of the restrictive assumptions about the analytical form of the charge distribution. (HBG)

28904 (AED-CONF-71-400, pp 289-297) DISPERSION EFFECTS IN ELECTRON SCATTERING. Toepffer, C. (Univ., Frankfurt am Main). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

In the elastic scattering of electrons, the virtual excitations of the nucleus can be described by an additional, absorptive imaginary potential. Further consideration is given to the electron scattering from the 0^- states in light e-e nuclei, which is forbidden in first order. (tr-auth)

28905 (AED-CONF-71-400, pp 335-345) GIANT DIPOLE RESONANCE IN ^{208}Pb. Bergere, R. (Univ., Frankfurt am Main). 1972.

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

The results of an eigenchannel (ec) continuum shell-model calculation of the giant dipole resonance of ^{208}Pb are reported as a typical example of a continuum shell-model calculation using the ec technique and as a particular example of a shell-model calculation for ^{208}Pb. The ec method calculates the S matrix at a given energy by an iteration technique. The results obtained for ^{208}Pb are found to be too high and narrow compared with experiment. It appears that the problem associated with the treatment of the particle continuum has been satisfactorily solved. (4 figures) (RWR)

28906 (AED-CONF-71-400, pp 347-357) STRUCTURE OF THE GIANT RESONANCES AND OF LOW-ENERGY COLLECTIVE BEHAVIOR. Arenhoevel, H. (Max-Planck-Institut fuer Chemie, Mainz); Rezwani, V. 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

The low-energy excitation states of nuclei are discussed. The spherical shape and the deformed, axially asymmetric shape are separated from each other by a barrier of about 2.5 MeV. From the structure of the giant resonances, important inferences can be made about the shape of the nucleus. (6 figures) (HBG)

28907 (BARC/I-212) NUCLEAR SHELL MODEL SINGLE PARTICLE BOUND-STATE CALCULATION. Pandey, S. R.; Ganguly, N. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 21p. INIS.

A numerical algorithm and descriptive narration of a computer program to calculate the wave function of a particle bound in a diffuse potential of fixed geometry are described. For given values of potential depths and radial parameters, the corresponding binding energies or for particular binding energies, the corresponding well depths can be calculated. Few sample calculations of nucleon density distribution together with its root mean square radius were carried out and were included. (auth)

28908 (BMFT-FBK-73-19) INVESTIGATION ON A UNIFIED THEORY OF NUCLEAR REACTIONS AND NUCLEAR STRUCTURE. Kanellopoulos, E. J. (comp.) (Tuebingen Univ. (West Germany). Institut fuer Theoretische Physik). Jul 1973. 124p. (In German). Dep. NTIS (U.S. Sales Only) $8.25.

A report is given on investigations on a unified theory of nuclear reactions and nuclear structure within the framework of cluster representations during the period 1971/1972 at the Institute for Theoretical Physics, University of Tübingen: Examples of a theory of nuclear reactions and nuclear structure (special problems in light nuclei, methods to manage the antisymmetrization in systems with a higher number of nucleons, rotational levels), symmetries of cluster configurations and application of group theoretical methods, test of reaction theories with respect to the three-body problem are discussed. (auth)

28909 (CONF-730815-3) NUCLEAR STRUCTURE STUDIES WITH LARGE SHELL MODEL CALCULATIONS. McGrory, J. B. (Oak Ridge National Lab., Tenn.). 1973. 17p. Dep. NTIS $3.00.

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973).

Nuclear structure studies using the conventional nuclear shell model are considered. Although applications of this model have been quite successful, it is not on a secure theoretical foundation: the model represents the first term in a perturbation series of which the convergence is not yet established. A recent advance in large-shell-model technology [Whitehead, Nucl. Phys., A182,

290 (1972)] is described whereby it is now possible to study almost all the sd-shell nuclei with A = 18 to 38 in the full $(sd)^n$ space. Thus, a study of the systematics of nuclear properties in the middle of the shell, where some interesting qualitative changes in nuclear structure occur, is now practicable. The usefulness of shell-model wave functions in the analysis of cluster-transfer data, which are being accumulated as a result of heavy-ion experiments, is then addressed. Finally, ways to extend the domain of applicability of the shell model further are discussed. (5 figures) (RWR)

28910 (IAE-2114) THEORETICAL SUBSTANTIATION OF SHELL CORRECTION METHOD. (Strutinsky Prescription) Grechukhin, D. P.; Pik-Pichak, G. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 32p. (In Russian). INIS.

An analysis was made of the theoretical substantiation of the Strutinsky shell correction method. In accordance with his work the shell correction to the semiempirical mass formula was interpreted in the framework of the Hartree–Fock method and the Thomas–Fermi method, in which is neglected a series of terms of quadratic and higher degrees on the fluctuation of the nucleon distribution. As a result of the present analysis it was established that this interpretation of the shell correction and the theoretical substantiation of the shell correction method are untenable. The approximations comprising the transition from the Hartree–Fock method to the Thomas–Fermi method lead in the case of nuclei, to order-of-magnitude differences and a much increased maximum observed value of the shell effect in the nuclear mass. The shell correction method is one of the variants of a purely computational formula which usually accompanies semiempirical mass formulas, based on the liquid drop nuclear model. The success or failure of such formulas for the computation of the shell effect is determined by means of the comparison of the calculation results with experimental data in a wide (N,Z) range of nuclei. (JSR)

28911 (JINR-E2-7278) INELASTIC INTERACTIONS OF HIGH ENERGY NUCLEONS WITH HEAVY NUCLEI. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 36p. Dep. NTIS (U.S. Sales Only) $4.00.

The intranuclear cascade model including the effect of changes in the properties of the target nucleus due to development of the shower of cascade particles is applied to calculations of the interactions of protons with fissioning nuclei in the energy region $T \simeq 0.1$ to 30 GeV. The fission cross sections, yields of different isotopes after evaporation stage, and the characteristics of accompanying particles are calculated. The properties of the excited evaporating and fissioning residual nuclei are discussed. The calculated results are compared with experiment. (auth)

28912 (LBL-1968) ROTATION-ALIGNED COUPLING SCHEME. Stephens, F. S. (California Univ., Berkeley. Lawrence Berkeley Lab). Jul 1973. Contract W-7405-eng-48. 39p. (CONF-730815-4). Dep. NTIS $4.00.

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973).

The rotation-aligned coupling scheme is defined, and it is shown why and where it is applicable in both the odd-A and even–even nuclei. (JFP)

28913 (LYCEN-7302) RECENT DEVELOPMENTS IN THEORETICAL NUCLEAR PHYSICS. (Lyon Univ. (France). Institut de Physique Nucleaire). 1973. 277p. (In French and English). (CONF-730214-).

Thirty-two papers were presented at the conference. They review two-body and three-body problems, problems encountered in the description of reactions between heavy ions, and problems in the description of nuclear structure. A separate abstract has been prepared for twenty of these papers. Two other papers have already appeared in NSA; for abstracts of these papers, see CONF-730214 in a cumulative report no. index. (FR)

For abstracts of individual papers see: 28659, 28660, 28709, 28731, 28732, 28790–28792, 28914–28924, and 29113.

28914 (LYCEN-7302, pp C1.1-C1.26) RECENT DEVELOPMENTS IN CLUSTER MODELS. Abgrall, Y.; Gabinski, P.; Labarsouque, J. (Bordeaux Univ., Talence, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

A comparison between the Hartree–Fock (HF) and α-particle models demonstrated that up to ^{20}Ne, the Brink–Margenau α model provides a simpler description giving more exact values for the energy than more sophisticated HF calculations. On the other hand, for ^{24}Mg and elements further on in the periodic table, the solutions obtained using the α model give wrong energy values and differ considerably from the solutions obtained with the HF model. In view of the discrepancies between these solutions and the experimental results, the model cannot be retained for such cases. Elastic and inelastic scattering tests provide a very rigorous test of the exactitude of nuclear models. Such tests reveal definite insufficiencies in the α model, particularly for the case of ^{12}C. It also appears that the zero-point vibrations in this nucleus do not have very significant effects on the form factors of the ground-state band. (FR)

28915 (LYCEN-7302, pp C3.1-C3.27) APPLICATION OF THE GENERATOR-COORDINATE FORMALISM TO THE STUDY OF TRANSFER REACTIONS BETWEEN HEAVY IONS. Bonche, P.; Giraud, B. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

An expression is sought for the nuclear matrix element appearing in the transition amplitude for transfer reactions between heavy ions. A microscopic expression is sought, the generator-coordinate formalism being used. (FR)

28916 (LYCEN-7302, pp C4.1-C4.8) NEW METHOD FOR DESCRIBING COLLECTIVE STATES IN NUCLEI. Bouten, M. (SCK/CEN, Mol, Belg.); Van Leuven, P.; Mihailovic, M. V.; Rosina, M. 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

A new method is presented for describing an N-nucleon system, which is developed from that of Rowe, and is based on operators transforming a stationary state into another stationary state. The method, designated the hermitic operator method, was tested by calculating several collective states for ^{8}Be and ^{12}C. The results obtained are compared with those of Rowe. (FR)

28917 (LYCEN-7302, pp C7.1-C7.9) RECOIL EFFECT AND FINITE RANGE IN DIRECT TRANSFER REACTIONS. Elbaz, E.; Meyer, J.; Nahabetian, R. (Univ., Lyon). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

A method is presented for treating recoil effects in any given direct interaction without any approximation; it enables the Buttle–Goldfarb approximation to be re-established using a hypothesis on the wave function of the captured particle. The only complication inherent in this treatment is the replacement of the usual radial integral by a double integral, which is easily calculated numerically. (FR)

28918 (LYCEN-7302, pp C9.1-C9.24) QUASI-ROTATIONAL STATES AND SOFTNESS OF NUCLEI. Jaffrin, A. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

Developments made in the field of nuclear rotation are discussed, some examples being given to demonstrate the limits of classical or intuitive concepts. The following subjects are thus treated: the semi-classical rotational model, deviations from the semi-classical rotational model, projection of the angular momentum, the behavior of a projected intrinsic state, nonadiabatic collective microscopic models, the method of diagonalization in an aligned scheme. In addition, some conclusions on the concept of the intrinsic state are presented. (FR)

28919 (LYCEN-7302, pp C12.1-C12.18) APPLICATION OF THE HYPERSPHERICAL FORMALISM TO NUCLEAR REACTIONS. Raynal, J. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

Hyperspherical functions are introduced for the three-body problem, together with the transformations of the hyperspherical harmonics. It is then shown how the hyperspherical formalism can be applied to nuclear reactions. (FR)

28920 (LYCEN-7302, pp C13.1-C13.14) EIKONAL APPROXIMATION FOR ELECTRON SCATTERING. Estimation of Dispersive Effects. Ripka, G. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

It is shown how the eikonal approximation enables a rapid estimation to be made of dispersive effects in the scattering of electrons by the Coulomb potential of a nuclear charge distribution. The case in which the target is an even–even deformed heavy nucleus is considered. (FR)

28921 (LYCEN-7302, pp S2.1-S2.6) LOWER BOUNDS TO GROUND STATE ENERGY OBTAINED BY VARIATIONAL CALCULATION OF DENSITY MATRICES. Rosina, M. (Univ., Ljubljana, Yugoslavia). 1973.

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

In Variational Calculations for Density Matrices the properties of the ground state are determined by calculating the 2-body density matrix directly, without using the wave function. It is shown that this variational method can be proposed as a complementary calculation method along with the modern variational approaches to wave functions. (FR)

28922 (LYCEN-7302, pp S3.1-S3.11) STUDY OF A FEW NONLOCAL INTERACTIONS IN INFINITE NUCLEAR MATTER. Meunier, J. P.; Pigeon, J. (Univ., Lyon). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The properties of infinite nuclear matter (binding energy per particle, saturation density, and defect parameter κ) were studied for different types of nonlocal interactions. The Brueckner–Goldstone G-matrix formalism was used in the first order together with different, generally accepted hypotheses. (FR)

28923 (LYCEN-7302, pp S11.1-S11.5) PROBLEMS WITH MEDIUM ENERGY CLUSTER KNOCK-OUT REACTIONS. Jain, A. K.; Sarma, N. (Bhabha Atomic Research Centre, Bombay). 1973.

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

Distortion effects in the analysis of medium energy cluster knock-out reactions are discussed. The analysis of the ^{6}Li(d,2d)^{4}He reaction at 27 MeV is presented as an example. A completely antisymmetrized cluster model wave function is used which fits the binding energy and electron scattering very well. A very good fit to the experimental data, both in shape and absolute value, is observed without any free parameters. (auth)

28924 (LYCEN-7302, pp S17.1-S17.11) SELF-CONSISTENT CALCULATION OF DEFORMATION ENERGY CURVES. ^{240}Pu Fission Barriers. Quentin, P. (CEN de Saclay, Gif sur-Yvette, France). 1973. (In French).

From 3rd study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The properties of the effective interactions utilized in some unconstrained Hartree–Fock calculations (spherical and deformed) are discussed. Self-consistent calculations of ^{240}Pu fission barriers were performed using the Hartree–Fock method with constraints on the quadrupole moment. The Skyrme effective force was used. (FR)

28925 RAINBOW INTERFERENCE EFFECTS IN HEAVY ION ELASTIC SCATTERING. Da Silveira, R. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 45B: No. 3, 211-213 (23 Jul 1973).

It is shown that the oscillatory behavior of differential cross section of heavy ion elastic scattering, which satisfies the semi classical conditions, is well described in terms of interference effects due to a rainbow. (auth)

28926 MESON EXCHANGE EFFECTS IN THERMAL n–p RADIATIVE CAPTURE. Colocci, M.; Mosconi, B.; Ricci, P. (Univ., Florence). Phys. Lett., 45B: No. 3, 224-226(23 Jul 1973).

It is shown that the meson exchange contributions to the n–p radiative capture matrix element are nearly independent from the nucleon–nucleon potential model. The resulting interaction effect, including the $N_{\frac{5}{2}}$ contribution calculated by Stranahan, is ~9%. (auth)

28927 FISSION MASS ASYMMETRY AS A DYNAMIC PROCESS DESCRIBED BY A COLLECTIVE COORDINATE. Lichtner, P. (Institut fuer Kernphysik, Mainz); Drechsel, D.; Maruhn, J.; Greiner, W. Phys. Lett., 45B: No. 3, 175-177 (23 Jul 1973).

A collective coordinate for describing reflection-asymmetric shapes of fissioning nuclei is introduced. The potential energy and mass parameter determining motion in this degree of freedom are calculated in a two-centre shell model. In quantized treatment the probability for a given mass asymmetry is determined and compared to the experimental mass yield curve of ^{236}U. (auth)

28928 COUPLED CHANNEL APPROACH TO THE OFF-SHELL TRANSITION MATRIX. Londergan, J. T. (Univ. of Wisconsin, Madison); Moniz, E. J. Phys. Lett.; 45B: No. 3, 195-198(23 Jul 1973).

A coupled-channel separable potential model with the feature that the off-shell transition matrix can be generated directly from the scattering phase shifts is proposed. This should be useful in constructing pion-nucleus optical potentials. (auth)

28929 CONFIGURATION MIXING IN VIBRATIONAL NUCLEI. Singh, R.; Mehta, G. K.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). Phys. Lett., 45B: No. 3, 199-202(23 Jul 1973).

The configuration-mixed wave functions for one-phonon and two-phonon 2^{+} states were obtained from the experimental energy spectra of the even–even vibrational nuclei. The reduced transition probabilities and electric quadrupole moments were calculated. (auth)

28930 MODIFIED MESON–NUCLEUS OPTICAL POTENTIALS. Wilkin, C. (CERN, Geneva). Phys. Lett., 45B: No. 3, 203-206 (23 Jul 1973).

It is argued that the energy dependence of the meson-nucleus optical potential should be treated in a more dynamical fashion. When this is done, some of the difficulties found in phenomenological applications are eliminated. (auth)

28931 TRANSFORMATION OF A COMPLEX SKEW-SYMMETRIC MATRIX INTO A REAL NORMAL FORM AND ITS APPLICATION TO A DIRECT PROOF OF THE BLOCH–MESSIAH THEOREM. Becker, H. G. (Univ., Bonn). Lett. Nuovo Cim.; 8: No. 3, 185-188(15 Sep 1973).

A simple proof of a theorem on the transformation of a complex skew-symmetric matrix into a real normal form is given. This theorem has an important role in the pairing theory of nuclei. The matrix theorem is applied to a direct proof of the Bloch–Messiah decomposition of the general Bogolyubov–Valatin transformation. It is concluded that the second transformation can always be chosen real. (JFP)

28932 NUCLEAR COMPRESSIBILITY. Zamick, L. (Rutgers–The State Univ., New Brunswick, NJ). Phys. Lett., 45B: No. 4, 313-314(6 Aug 1973).

A simple formula is obtained, which relates the nuclear compressibility to the binding energy per particle, the mean kinetic energy per particle, and the power of the density appearing in the two body interaction. (auth)

28933 WAVEPACKETS AND ANALYSIS OF LIFETIME MEASUREMENTS OF COMPOUND NUCLEI. Yoshida, S. (Rutgers–The State Univ., New Brunswick, NJ). Phys. Lett., 45B: No. 4, 324-326(6 Aug 1973).

Without assuming that the time duration of wave packets is much shorter than the lifetime of the nuclei, the nondecaying probability of compound nuclei as a function of the time is calculated. (auth)

28934 α-DECAY OF HIGHLY EXCITED STATES OF DEFORMED NUCLEI. Voronov, V. V.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 922-928(May 1973). (In Russian).

The reduced probability of α transitions from highly excited states, described by wave functions containing a large number of components with a different number of quasi-particles, was derived for the ground, single-phonon, and single-quasi-particle states of deformed nuclei. (tr-auth)

28935 T-NONINVARIANT ANGULAR CORRELATIONS IN PAIR CONVERSION PROCESSES. Vlasov, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1016-1018(May 1973). (In Russian).

By use of the amplitude of the pair conversion and assignment of the initial state of the nucleus, complete correlation functions were obtained. The formulas obtained indicate the possibility of verification of the T invariance of the nuclear radiative transition in tests on the measurement of the angular correlation in pair conversion processes in polarized nuclei. (JSR)

28936 SIMPLE CONSIDERATION OF THE NONSINGLE-PARTICLE MECHANISM OF THE PROTON DECAY OF ISOBARIC-ANALOG RESONANCES. Aleshin, V. P. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1088-1094(May 1973). (In Russian).

It was shown in what sense the proton decay of isobaric-analog states can be examined as single-particle processes. A simple evaluation was also made, along with an investigation of the non-single-particle corrections to the width. (4 figures) (JSR)

28937 THEORY OF ODD–ODD NUCLEI WITH SMALL NON-AXIALITY. Giyazov, I.; Sharipov, Sh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 5, 1125-1128(May 1973). (In Russian).

The energy spectrum of the excited states of odd–odd nuclei with small nonaxiality was calculated for the region $N_p = N_n = 1,2$. (2 figures, 1 table) (tr-auth)

28938 EXCITATION OF NUCLEAR LEVELS BY ELECTRONS AND HADRONS AT HIGH ENERGY. Kondratyuk, L. A.; Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 435-437(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 619-621(5 Jun 1973).

It is shown that at high energies there exists a unique connection between the excitation cross sections of a definite series of nuclear

transitions in electron and hadron beams. This series includes transitions that can be realized by exchange of states with natural parity in the t-channel, i.e., transitions of the type $0^+ \rightarrow 0^+$, 1^-, 2^+, 3^-, etc. The scattering of a hadron by a nucleus within the framework of the multichannel optical model is considered. Formulas for the total inelastic and elastic scattering are given. It is found that the cross section can yield important information on the structure of the nuclear surface. (JFP)

28939 KINETIC CONSTRAINTS AND COLLECTIVE MOTIONS. Amiot, P. College Park, MD; Univ. of Maryland (1972). 225p. University Microfilms Order No. 73-18,723.

Thesis (Ph. D.).

A theory is developed to define the Hamiltonian of a constrained system by introducing the constraint function in a Lagrangian with the help of the familiar Lagrange multipliers. The constrained Hamiltonian is defined from this Lagrangian to insure that the canonical equations will hold. This warrants the subsequent quantization of the Hamiltonian, from which the dependence of the wave functions on the Lagrange multipliers provides the degrees of freedom necessary for the equations of constraint to be satisfied "on the average." This procedure is applied to a description of some familiar collective motions of an N-body system, such as the center of mass motion, the rotations and the variations in the shape of the density. It leads to an expression for the collective energy from which, by classical analogy, collective inertiae are identified which compare favorably with expressions obtained from other methods. An exactly soluble single particle model is set up where the potential can be deformed by symmetric elongation and necking-in or separation into two fragments of variable relative sizes (asymmetry). The results of the study on the effects of necking-in and asymmetric deformation on single particle wave functions and energies are used in an investigation of single particle effects, E_{sh}, on the potential describing the dynamics of density shape deformations of an N-body system. In the limit of slow deformation, E_{sh} is observed to fluctuate irregularly as the elongation is increased, (Strunski's effect). In the limit of rapid deformation, these fluctuations are more regular i.e., they are conserved as the elongation is increased. With negative result, the possibility that low inertia regions, in deformation space, may be an effective mechanism in generating this rapid deformation process is investigated. (Diss. Abstr.)

28940 RESONANCE INTERFERENCE EFFECTS IN FAST-NEUTRON REACTIONS. Rogers, V. C. (Brigham Young Univ., Provo, UT). Nucl. Sci. Eng.; 52: No. 1, 145-147(Sep 1973).

Within the framework of the Hauser–Feshbach–Moldauer formalism for calculating fast-neutron cross sections, resonance interference effects are contained in the parameter Q. This parameter is shown to be a function of the corresponding transmission coefficients. From a parametric analysis of Q and of the channel coefficients, it is concluded that resonance interference has a negligible effect on the calculated cross sections. (auth).

28941 APPLICATION OF THE LANCZOS ALGORITHM FOR THE MATRIX EIGENPROBLEM TO OTHER THAN NUCLEAR SHELL MODEL CALCULATIONS. Nissimov, H. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 46B: No. 1, 1-4(3 Sep 1973).

An application of the Lanczos algorithm for the tridiagonalization of a finite matrix to shell model calculations has been recently suggested. The possibility to extend this method to cases where states lying in the continuum are included is studied. First, a model is treated where a numerical value to the ground state energy is given in advance but the potential and the nature of the system are arbitrary. By means of this model it is shown that the extension is possible. Next, a practical application of the method in treating a two-body system is demonstrated. The results are promising. (auth)

28942 SCATTERING CALCULATIONS FOR THREE-BOSON SYSTEMS. Hoffman, H.; Schmid, E. W.; Schuetz, M.; Schwager, J.; Sohre, F.; Ziegelmann, H. (Univ., Tuebingen, Ger.). (1973). vp. (In German).

From Spring meeting of the Deutsche Physikalische Gesellschaft. Part A, Nuclear Physics; Heidelberg, Germany (19 Feb 1973).

The mathematical principle of most nuclear reaction theories does not allow the approximate neglect of open channels. For the three-boson scattering as an example it is shown that false resonances occur if the three-particle breakup is neglected. By a modification of the mathematical principle (in the sense of the least-squares-method) solutions can be found in the same space of test functions that are free from false resonances and that lead to a better approximation. The same principle can be applied to the shell model theory of nuclear reactions. First calculations show that a suppression of resonances with a highly excited center-of-mass motion is possible. As a further problem the numerical solution of the equations by Alt, Grassberger and Sandhas above the threshold for three-particle breakup is treated. (GE)

28943 ELECTRIC DIPOLE SUM RULE FOR NUCLEAR PHOTOEFFECT. Matsuura, T.; Yazaki, K. (Tokyo Univ.). Phys. Lett.; 46B: No. 1, 17-19(3 Sep 1973).

Gerasimov's argument on the E1 sum rule for nuclear photoeffect is shown not to hold exactly in simple nonrelativistic models. The retardation effect does not precisely cancel the contribution of higher multipoles and remaining terms have about the same magnitude as the cancelled ones. They are also found to be of the order of relativistic correction so that the consistent argument on the higher multipole and retardation effects seems to require a relativistic treatment. (auth)

28944 EFFECTIVE MASS CONCEPT AND THERMAL PROPERTIES OF NUCLEAR MATTER. Stocker, W. (Univ., Munich). Phys. Lett.; 46B: No. 1, 59-61(3 Sep 1973).

The schematic model of nuclear matter proposed by Gomes, Walecka and Weisskopf (1958) is generalized to finite temperatures including interacting Fermi particle aspects. Thermal nuclear properties are discussed; arguments are given that the effective mass at the Fermi surface may be approximated by the free nucleon mass. (auth)

28945 ANTISYMMETRIZED DEUTERON–NUCLEUS SCATTERING. Austern, N. (Univ. of Pittsburgh). Phys. Lett.; 46B: No. 1, 49-50(3 Sep 1973).

A practical procedure for calculating antisymmetrization effects is outlined. It is seen that these effects are neither large nor unusual. (auth)

28946 EXTENSION OF BELYAEV–ZELEVINSKI METHOD FOR ROTATION AS INTRINSIC NUCLEAR EXCITATION. Gray, J. W.; Greenberg, N. I. (State Univ. of New York, Binghamton). Phys. Lett.; 46B: No. 1, 34-36(3 Sep 1973).

The method of Belyaev–Zelevinski is extended and it is shown how more complicated forms of the rotational energy can be obtained in lowest order. (auth)

28947 EFFECT OF SINGLE NUCLEUS OF THE TARGET NUCLEI ON THE AVERAGE FIELD. Based on the Theory of Rough Structure of Nuclear Reactions. Jen, K. W. Wu-Li; 1: No. 1, 19-27(Jun 1972).

By applying the method of grouping differential equations to the three-body Schrodinger equation, and using the central-force approximation, a study is made of the effect of the new nucleus on the original two-body system (incident nucleus and the original target nuclei). The results are shown to be consistent with those obtained from the model theory. (auth)

28948 CLUSTER STRUCTURE AND INELASTIC INTERACTIONS OF FAST PROTONS WITH A LIGHT NUCLEI. Abdinov, O. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 119-122(1972). (In Russian).

The cascade evaporative model in light nuclei was examined for examples of inelastic interactions of 660-MeV protons with nuclei. The cascade phase of the calculation was carried out with consideration of the α cluster and local changes of the density of the nuclear matter in proportion to the development of cascade avalanches. The decay of the strongly excited nuclei-radical, formed after completion of the cascade stage of the interaction, was examined by the Fermi decay model. The calculation was done with consideration of the distribution of the α cluster both with respect to the nuclear radius and the number of α associations in the nucleus. The calculation results were compared with experimental data. (tr-auth)

28949 GAMMA–NEUTRINO ANGULAR CORRELATIONS IN MUON CAPTURE. Devanathan, V. (Univ. of Madras). p 71 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28950 (d,p) REACTION THEORY INCLUDING DEUTERON BREAKUP CHANNEL. Ray, S.; Samaddar, S. K.; Mukherjee, S. (Saha Inst. of Nuclear Physics, Calcutta). pp 77-81 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28951 DISTORTED-WAVE AND DISPERSION THEORIES OF DIRECT NUCLEAR REACTIONS. Sheth, B. I. (South Gujarat Univ., Surat, India). pp 83-85 of Proceedings of the Nuclear

Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28952 ANALYSIS OF POLARIZATION OF SCATTERED PARTICLES. Takwale, R. G. (Univ. of Poona, India); Teli, M. T. pp 89-93 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28953 INTERPLAY BETWEEN ON-SHELL AND OFF-SHELL REACTION MATRIX ELEMENTS. Srivastava, M. K. (Univ. of Roorkee, India). pp 95-99 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28954 ENERGY VARIATION OF REAL OPTICAL POTENTIAL FOR PROTONS. Srivastava, D. K.; Sinha, B. C.; Ganguly, N. K. (Bhabha Research Centre, Trombay, India). pp 125-129 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28955 INVESTIGATION OF THE ACCURACY OF THE UNITARY POLE APPROXIMATION. Srivastava, M. K.; Sirchi, A. P. S. (Univ. of Roorkee, India). pp 163-166 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28956 REGION OF VALIDITY OF THE SHAPE-FLUCTUATION MODEL. Satpathy, M.; Satpathy, L. (Berhampur Univ., India). pp 191-196 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28957 NEGATIVE ISOMER SHIFTS AND MODELS OF ROTATIONAL SPECTRA. Mantri, A. N.; Sood, P. C. (Banaras Hindu Univ., India). pp 197-201 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28958 GOVERNOR MODEL OF GUPTA AND TRAINOR AND ITS APPLICATION TO NUCLEAR FISSION. Gupta, R. K. (Panjab Univ., Rohtak, India). pp 203-208 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28959 OCCUPATION PROBABILITIES IN RENORMALIZED BRUECKNER-HARTREE-FOCK THEORY OF FINITE NUCLEI. Rao, S. Y. (Tata Inst. of Fundamental Research, Bombay). pp 217-220 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28960 ANGULAR MOMENTUM ANALYSIS OF THE JJ-COUPLING SHELL MODEL. Satyanarayara Rao, A. (Andhra Univ., Waltair, India). pp 229-232 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28961 MIXING OF STATES WITH $\Delta N = \pm 2$ IN NUCLEAR SPECTRA AND THE TRANSITION PROBABILITIES. Sharma, S. D. (Panjabi Univ., Patiala, India). pp 235-239 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28962 SMEARING OF THE MULTIPLE HARTREE-FOCK (HF) MINIMA BY THE HARTREE-FOCK-BOGOLYUBOV (HFB) CORRELATIONS. Sharma, S. K. (Physical Research Lab., Ahmedabad, India). pp 279-282 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28963 INADEQUACY OF THE HARTREE-FOCK STATE TO DESCRIBE A ROTATING INTRINSIC STATE OF A NUCLEUS. Khadkikar, S. B.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 283-287 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28964 MINIMIZATION OF ENERGY VARIANCE FOR DETERMINANTAL STATES AS A USEFUL VARIATION ON THE HARTREE-FOCK THEME. Parikh, J. C.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 293-296 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28965 SPREADING OF SU(4) REPRESENTATIONS AS A MEASURE OF SYMMETRY BREAKING. Haq, R.; Parikh, J. C. (Physical Research Lab., Ahmedabad, India). pp 299-302 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28966 COUPLING TOGETHER TWO FINITE 'ROTATORS' BY $Q^4 \cdot Q^4$ AND $Q^6 \cdot Q^6$ INTERACTIONS. Sharma, S. K.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 331-334 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

28967 SEMI-CLASSICAL DERIVATION OF THE SPIN-ORBIT ELECTROMAGNETIC INTERACTION. Gomez, J. M. G. (Univ. of Copenhagen); Sesma, J. Lett. Nuovo Cim.; 7: No. 16, 851-854 (18 Aug 1973).

The general form of the two-body electromagnetic spin-orbit interaction is considered and its application in calculating the energy difference of analog states in nuclei with one particle outside closed shells. (JFP)

28968 DMIT: A SMALL COMPUTER OPTICAL MODEL CODE FOR PION SCATTERING. Hungerford, E. V. III (Rice Univ., Houston, TX). Nucl. Instrum. Methods; 111: No. 3, 509-517(1973).

A Fortran computer code for the optical model calculation of pion nucleus scattering was written for small computer systems. The code is operational on both an IBM-1800 and a PDP-11 data acquisition computer. It allows calculation with both the Laplacian and Kisslinger optical models using either a modified Gaussian or a Fermi nuclear density. The code gives results in agreement with other pion optical model codes. (auth)

28969 GENERATOR COORDINATE METHOD FOR NUCLEAR BOUND STATES AND REACTIONS. Review of Contributions and Discussions at the Working Seminar, Ljubljana, Yugoslavia, August 13-September 9, 1972. Fizika, Suppl. (Zagreb); 5: 1-88 (1973).

The discussion covers the general theory and mathematical problems, bound states, and the generator coordinate method for nuclear reactions. (JFP)

28970 NEUTRINO-INDUCED EXCITATION OF NUCLEI. Tsinoev, V. G.; Zakharov, L. N. Yadern. Fiz.; 18: No. 2, 390-392(Aug 1973). (In Russian).

Cross sections are calculated for excitation of nuclei induced by low-energy neutrinos due to the electromagnetic and weak interactions. It is shown that under certain conditions a separate investigation of each of the interactions is possible. (auth)

28971 COLLECTIVE MOTIONS OF THE ISOSPIN DEGREES OF FREEDOM OF A SYSTEM OF PAIRED NUCLEONS. Chen, H. T. (Univ., Sao Paulo, Brazil); Richardson, R. W. Nucl. Phys., A212: No. 2, 317-340(1973).

Group theoretical techniques are used to obtain wave functions and energies for states of the charge independent pairing Hamiltonian that have intermediate isospin symmetry and arbitrary total isospin. The results are related to existing approximate theories and both the analytical relation to and a numerical comparison with the pairing rotation-vibration model are given. (auth)

28972 CHARGE VIBRATIONS IN THE LIQUID-DROP MODEL OF FISSION. Holub, R.; Choppin, G. R. (Florida State Univ., Tallahassee). Nucl. Phys., A212: No. 2, 387-412(1973).

The two-spheroid liquid-drop model of fission developed by Nix and Swiatecki was extended to include charge vibrations. Using the Myers-Swiatecki mass formula, the appropriate stiffness constants were obtained in analytic form. The effective mass, M_Δ, associated with charge vibrations for fission shapes was deduced from eigenenergies for the giant dipole resonance calculated by Updegraff and Onley, assuming that the eigenenergy is given by $\hbar\omega_{dipole} = \hbar\sqrt{K_{\Delta\Delta}/M_\Delta}$, where $K_{\Delta\Delta}$ is the stiffness for charge vibrations. To account for the experimental charge dispersion widths a highly constricted fission shape was chosen. The dependence of fragment deformation energy on mass increases more rapidly than in the Nix and Swiatecki treatment when the eigenvalues of two new normal modes have similar values; it is concluded that this, together with spherical closed-shell effects, may explain the discrepancy between the Nix and Swiatecki values and experimental data. Various other aspects of the effect of charge vibrations are discussed. (auth)

28973 FINITE RANGE APPROXIMATIONS IN DIRECT TRANSFER REACTIONS. Santos, F. D. (Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal). Nucl. Phys., A212: No. 2, 341-364(1973).

Finite range effects in direct transfer reactions are discussed using an irreducible tensor expansion of the translation operator. The local energy approximation is generalized to nonzero orbital angular momentum in the projectile and the expansion coefficients are given as integrals of the reaction form factor radial dependence. This enables a more accurate determination of the finite range parameter β. An expansion of the transition amplitude appropriate to heavy ion transfer is obtained. The form factor of each term is given analytically for bound state wave functions expressed as a sum of spherical Hankel functions. The inclusion of recoil effects is thereby greatly simplified. Using the approximate treatment of Dodd and Greider the calculation retains the structure of a DWBA zero range code. A strongly inhibitory selection rule for the orbital angular momentum transfer in the reaction due to recoil is presented and discussed. (auth)

28974 SELF-CONSISTENT (NUCLEAR) PHONONS. Schuck, P. (Massachusetts Inst. of Tech., Cambridge); Ethofer, S. Nucl. Phys., A212: No. 2, 269-286(1973).

In the light of the Dyson equation approach to higher correlation functions derivation of the RPA equations is reinvestigated. Self-consistent equations are obtained for the RPA amplitudes X and Y which reveal a great analogy to the usual type of Hartree-Fock equations for fermions. The theory was applied to the simplified many fermion model of Lipkin, Meshkov, and Glick and the solution was found to have useful properties: the SCRPA equations have a real solution for arbitrary interaction strength and the exact (anharmonic) spectrum is approximated in an optimal way by this (harmonic) solution. Also the relation of the theory with the Marumori boson expansion method was investigated. It turns out that there is a close correspondence, which then is also true for Sørensen's as well as Da Providencia's prescription to find a "best boson". (auth)

28975 COMPETITION BETWEEN CORIOLIS-ANTI-PAIRING AND DECOUPLED BAND HYBRIDIZATION IN NUCLEI. Sheline, R. K. (Florida State Univ., Tallahassee). Phys. Lett., 45B: No. 5, 459-462(20 Aug 1973).

The anomalous behavior of the rotational motion in high spin states of deformed nuclei is ascribed to a combination of both Coriolis-anti-pairing (CAP) and hybridization of decoupled band (HDB). Calculations suggest that the CAP effect should be most important for light nuclei, the HDB effect for actinide nuclei while the two effects should compete in the nuclear region $100 \leq A \leq 190$. (auth)

28976 COMPOUND-NUCLEUS CONTRIBUTIONS TO THE T_{20} ANALYZING POWER IN (d,p) REACTIONS. Meyer, H. O.; Friedman, W. A. (Univ. of Wisconsin, Madison). Phys. Lett., 45B: No. 5, 441-444(20 Aug 1973).

The inclusion of compound nucleus contributions in the calculation of the energy averaged tensor analyzing power T_{20} in (d,p)-reactions was investigated. The sign of the compound effect at $\theta = 0°$ is shown to be dependent on the spin of the final nucleus. For T_{20} at forward angles sign and order of magnitude of the discrepancies between measurements and DWBA calculations including the deuteron D-state can be explained by compound effects. (auth)

28977 NONPERTURBATIVE SCHEME FOR THE CALCULATION OF THE EFFECTIVE INTERACTION IN NUCLEI. Hofmann, H. M. (Univ., Heidelberg); Lee, S. Y.; Richert, J.; Weidenmueller, H. A.; Schucan, T. H. Phys. Lett., 45B: No. 5, 421-424(20 Aug 1973).

Padé approximants are used to calculate the effective interaction W. Numerical studies indicate that this W approximately reproduces those eigenvalues of the full Hamiltonian for which the associated wave functions have maximum overlap with the model space. This W is the effective interaction of the shell model. The method of calculation is applicable when the usual perturbation expansion for W diverges. (auth)

28978 PROPERTIES OF THE EFFECTIVE INTERACTION FOR A SIMPLE 2×2 MATRIX. Ellis, P. J. (Nuclear Physics Lab., Oxford); Osnes, E. Phys. Lett., 45B: No. 5, 425-428(20 Aug 1973).

A 2×2 matrix is used to discuss the properties of the effective interaction. It is found that while the perturbation series ordered in powers of the perturbing Hamiltonian may diverge, it is possible to reorder the series such that it is convergent. In some cases it is found to converge to the lower eigenvalue and in some cases to the upper one. (auth)

28979 ACCURACY OF THE POLE APPROXIMATION IN THE FOUR PARTICLE INTEGRAL EQUATIONS. Narodetskii, I. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 1, 67-72(Jul 1973). (In Russian).

Contribution from the channel 3×1 to the discrete spectrum of a four-particle system having the α-particle quantum numbers, $S = T = 0$, $L^P = 0^+$, is calculated. The pole–approximation calculations are compared with the exact results for the Yamaguchi-potential. (auth)

28980 ANALYSIS OF INELASTIC COLLISIONS OF SUPERHIGH ENERGY PARTICLES WITH NUCLEI. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 1, 196-201(Jul 1973). (In Russian).

Experimental data on the pion–nucleus and nucleon–nucleus interactions at energies, much higher than 10 GeV, are analyzed on basis of the cascade-evaporative model with account of decrease of the internuclear nucleon density in process of development of the cascade. The experiment and the theory may be made to agree for the energies $\lesssim 100$ GeV, up to the measurement errors. At higher energies the calculated multiplicity of the shower particles is essentially more than the average experimental values. Effect of many-particle interaction is discussed. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

28981 PLASMA PHYSICS INDEX. Volume 8, No. 8, 1973. Bibliography, Author Index, Subject Index. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 162p.

Confinement and Heating

Refer also to abstracts 29035, 29042, and 29058.

28982 (GULF-GA-A-12229) MEASUREMENT OF NEOCLASSICAL DIFFUSION IN THE DC OCTOPOLE. Ohkawa, T.; Tamano, T.; Prater, R. (Gulf General Atomic Co., San Diego, Calif.). 15 Jul 1972. Contract AT(04-3)-167. 28p. Dep. NTIS $3.50.

The plasma transport rates in the dc Octopole device are measured for various values of collision frequency. The diffusion rates are proportional to the inverse square of the magnetic field strength independent of collision frequency. For short mean-free path regimes, the experimental results agree with the Pfirsch–Schlueter theory in magnitude of the coefficient and dependence on temperatures and density. For the long mean-free path regime, the results agree with the neoclassical theory. The value of the mean-free path where the transition from the classical to neoclassical diffusion, agrees with the theory for a wide range of temperature and density. (auth)

28983 (LPS-118) STRAIGHT AND TOROIDAL PLASMA EQUILIBRIA WITH AN INTENSE RELATIVISTIC ELECTRON CURRENT COMPONENT. Mondelli, A.; Ott, E. (Cornell Univ., Ithaca, N. Y. Lab. of Plasma Studies). May 1973. 36p. Dep. NTIS $4.00.

The equilibrium of an axisymmetric, large aspect-ratio, finite-temperature toroidal plasma enclosed by a perfectly conducting toroidal container is investigated. The new feature of the analysis is the presence of a relativistic electron beam which circulates around the torus, thus producing a poloidal magnetic field in addition to the external field and the field created by currents in the plasma. This problem may be of interest in connection with recent toroidal beam injection experiments at Cornell University, and tokamaks. The equilibria are obtained from the relativistic virial theorem. Specific examples are given wherein the plasma pressure is characterized by its dependence on the magnetic flux function and the relativistic electron beam is characterized by an electron distribution function which is a delta function in energy and canonical momentum in the toroidal direction. (auth)

28984 (MATT-Q-29) ANNUAL REPORT, JANUARY 1–DECEMBER 31, 1971. (Princeton Univ., N. J. Plasma Physics Lab.). Jun 1972. Contract AT(11-1)-3073. 181p. Dep. NTIS $11.25.

The program of the Princeton University Plasma Physics Laboratory for 1971 is summarized in the reviews of theory, experiment, and engineering. The developments which stand out are: (1) many advances in understanding of the operation of the ST Tokamak are reported; (2) the new spherator, FM-1, was brought into operation; (3) major fabrication was carried out on the ATC device; and (4) a major effort was conducted on the design and predicted performance of the next generation tokamak, the PLT device. Other important components of the program in 1971 included basic theoretical and experimental studies on parametric instabilities; a heavy emphasis in the theoretical program on linear and nonlinear kink stability; the establishment of a full-fledged reactor studies program. (MOW)

28985 HYBRID LASER PLASMA TARGET: NEUTRAL BEAM INJECTION FUSION SYSTEM. Haught, A. F.; Polk, D. H.; Woo, J. C.; Fader, W. J. (to United States Atomic Energy Commission). U. S. Patent 3,755,073. 28 Aug 1973. Filed Date 21 Jun 1971. 12p.

This invention relates to a method for creating a high-density plasma by heating in a vacuum a pellet located within a magnetic field to produce a dense, magnetically confined, relatively warm plasma of ions and electrons, and injecting thereinto an energetic neutral beam to form a high-temperature, stable, magnetically confined, steady-state plasma. (Official Gazette)

28986 LIFETIME OF CHARGED PARTICLES IN A HELIUM PLASMA. Konovalov, V. G.; Pavlova, G. P.; Pavlichenko, O. S. (Physical-Technical Inst., Kharkov). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 9, 1486-1491(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1854-1860(Sep 1972).

Calculations are carried out based on the spectroscopic method of measuring the ionization terms in the charged-particle balance equation in a helium plasma. The calculations are performed using the corona model and the collision–radiation model. Using the absolute measurements of the intensity of the He I (5016 Å) and He II (4686 Å) spectral lines, an estimate is made of the lifetime of the charged particles in the ohmic plasma of the Uragan stellarator. (auth)

28987 ELECTRON TEMPERATURE IN A COLD PLASMA IN A STRONG ELECTRIC FIELD. Mitrofanov, A. V. (Inst. of Physical Problems, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 9, 1509-1511(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1882-1885(Sep 1972).

An elementary theory is given for the electron temperature of a cold plasma in a strong electric field. A "superheating" electron instability in a collisional plasma is found for an arbitrary temperature dependence of the effective momentum-transfer cross section for collisions of electrons with heavy particles. The possibility of electron superheating is considered for real gases. (auth)

Diagnostics

28988 (AD-759544) MICROWAVE RESONANCE SHIFT METHOD IN STELLARATOR PLASMA DENSITY MEASUREMENTS. Coulbourn, D. W.; Sesnic, S. S. (Texas Univ., Austin. Electronics Research Center). 15 Mar 1972. Contract F44620-71-C-0091. 56p. (TM-27; AFOSR-TR-73-681). NTIS.

To investigate the trapping efficiency of a hot-electron plasma and its confinement in a toroidal magnetic field configuration, a small, adiabatically heated, symmetric stellarator was constructed. Various diagnostic methods are used to find various plasma parameters: electron density and temperature, confinement time, etc. One technique to find electron density and confinement time is to use the microwave cavity frequency-shift method. This method is especially applicable in the case of this stellarator since the size of the stainless steel toroidal container is such that it can support the lowest resonant modes with frequencies about 4 GHz. The resonance frequency shift method pertaining to a cylindrical resonator is reviewed, and the theory applicable to the toroidal geometry is discussed. The resonant mode structure in a toroidal resonator is described. It is shown in numerical examples that the presence of plasma will cause a considerable shift in the resonant frequency of the cavity. This frequency shift is directly proportional to plasma density and is also influenced by the magnetic field. (auth)

28989 (EUR-CEA-FC-694) TEST ON RED-SENSITIVE PHOTOMULTIPLIERS. Hesse, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nuclearies). May 1973. 38p. (In French). Dep. NTIS (U.S. Sales Only) $4.00.

New fast photomultipliers having high quantum efficiencies in the red-wavelength region were developed in view of Thomson scattering experiments with a ruby laser (6943 Å). The results demonstrate the improved detection characteristics, but indicate that these photomultipliers have very special and sometimes delicate uses: small continuous luminous flux incident on the photocathode at small saturation anode currents. (FR)

28990 (NP-19844) DESIGN AND FEASIBILITY TEST OF THE 90° THOMSON-SCATTERING EXPERIMENT FOR SPICA. Rijnhuizen Report 73-77. Khoe, G. D.; Jahoda, F. C.; Barth, C. J.; Aarts, H. J. M. (Stichting Voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Jul 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

A position scanning Thomson-scattering experiment using a Q-switched ruby laser and a ten-channel polychromator was designed to measure local electron temperatures and densities of SPICA. The stray light level was determined by Rayleigh scattering in a dummy setup, constructed using a $\frac{1}{8}$ section of the SPICA quartz torus. A complete prototype system was successfully tested on a hollow-cathode arc. (auth)

28991 MEASUREMENT OF ELECTRON DENSITY IN A CYLINDRICAL ELECTROSTATIC CONFINEMENT DEVICE. Meeker, D. J. Urbana, IL; Univ. of Illinois (1972). 85p. University Microfilms Order No. 73-17,323.

Thesis (Ph.D.).

An experimental investigation is described for the spatial variation in electron density in a cylindrical electrostatic confinement

device. Electrostatic confinement is one method of many proposed to contain a plasma at fusion conditions. The model hypothesized for describing the confinement principle of containing a fusionable gas requires an alternating structure in net charge in the center of the device and a trapping of charged particles by these alternating charge layers. Two diagnostic methods were used to investigate the charge structure: (1) microwave signals of 4- and 8-mm wavelengths employing both longitudinal and transverse modes to measure the average electron density, and (2) a laser heterodyne system at a wavelength of 3.39μ to spatially resolve the electron density distribution by scanning the discharge. The plasma was formed by pulsing a permeable cylindrical electrode resulting in injection of ions or electrons into the center of the device. The microwave data obtained show a linear increase in electron density as a function of center electrode for electron injection, but a nonlinear relation between current and electron density for ion injection. This implies a trapping of the electrons for ion injections, as the nonlinear increase is due to the electrons forming electron–ion pairs within the center electrode. Scans taken with the laser heterodyne system show a distinct oscillatory form of electron density as a function of radius for both electron and ion injection, with densities of 8×10^{11} electrons/cm^3 and variations in maxima to minima exceeding 30% of the average density. This implies a nonuniform plasma variation, as the electron densities measured cannot be a net charge with the voltages used. (Diss. Abstr. Int., B)

28992 TIME-RESOLVED SPECTROSCOPY OF A HIGH-TEMPERATURE, HIGH-DENSITY PLASMA IN A VACUUM SPARK. Turechek, J. J. College Park, MD; Univ. of Maryland (1972). 92p. University Microfilms Order No. 73-18,747.

Thesis (Ph.D.).

Reported are the results of time-resolved spectroscopic measurements from the near infrared to the x-ray region of the emission from a low-inductance, high-current vacuum spark. By varying the discharge parameters the operation of the device was optimized to produce a small plasma "focus" with reproducible temperatures of 30 keV, densities better than 10^{20} cm^{-3}, and containment times as high as 20 nanoseconds. X-ray spectra from helium-like and hydrogen-like ions were observed for elements of nuclear charge as high as that of molybdenum, and these correspond to the highest ionization stages heretofore reported in a laboratory plasma. The wave-lengths and intensities of the line spectra of these ions are compared with theoretical predictions and the presence of unexpected features is noted. Included is a history of the spark and a summary of the literature on the theory of its operation. (Diss. Abstr. Int., B)

28993 MEASUREMENT OF TURBULENCE WITHIN COLLISIONLESS PLASMA SHOCKS USING COLLECTIVE SCATTERING OF RUBY LASER LIGHT. Machalek, M. D. Austin, TX; Univ. of Texas (1972). 11p. University Microfilms Order No. 73-18,464.

Thesis (Ph.D.).

Experimental data was obtained on the character of the turbulence contributing to heating of plasma in collisionless shock waves. Frequency, wavelength and directions of propagation of turbulence waves in shocks moving perpendicular to an initial magnetic field were measured in the Texas Oblique Plasma Shock. The diagnostic technique of forward scattering of ruby laser light (6943 Å) was employed to obtain wavelength ($\bar{k}_s$) and frequency (ω) spectra of the turbulence. For the particular initial plasma used ($n_{eo,io} \simeq 4.3 \times 10^{14}$ cm^{-3}, B_{Zo} = 350 to 1000 g, $T_{eo} \sim T_{io} \sim 1$ eV) the angle of scattering for which $k_s\lambda_D = 1$ (λ_D = Debye length) behind the shock is ~5° from the forward beam direction. For geometric arrangements viewing light scattered at angles $\lesssim 5°$, $k_s\lambda_D < 1$ and the scattered light corresponds to collective plasma effects, i.e., wave motion. (MOW)

Kinetics (General)

28994 (AD-759183) TURBULENT FLOW PREDICTIONS FOR THE ARGON CASCADE ARC. Final Report, 21 November 1971–20 November 1972. Bower, W. W.; Incropera, F. P. (Purdue Univ., Lafayette, Ind.). Mar 1973. Contract F33615-72-C-1271. 58p. (ARL-73-39). NTIS.

A numerical model for the turbulent flow of argon in an arc was solved for both water-cooled and transpiration-cooled configurations. Although the agreement with data obtained for a 1 cm diameter water-cooled arc is good, there is poor agreement with measured results for the transpiration-cooled arc. For the transpiration-cooled arc, the data is better corroborated by a laminar flow model. Turbulent flow parametric calculations were performed for a large (2.54 cm diameter) water-cooled arc. (auth)

28995 (AD-759572) PROCEDURE FOR TURBULENT ARC CALCULATIONS. Interim Report, 21 November 1971–20 November 1972. Bower, W. W.; Incropera, F. P. (Purdue Univ., Lafayette, Ind.). Mar 1973. Contract F33615-72-C-1271. 65p. (ARL-73-38). NTIS.

A mathematical model is formulated for turbulent flow in both water-cooled and transpiration-cooled electric arcs. The model provides for the determination of flow profiles (velocity, temperature, turbulent shear stress, etc.) as well as for the determination of overall arc characteristics (electric field intensity and wall heat transfer). A finite-difference solution to the model is developed. (auth)

28996 (AD-760792) NONEQUILIBRIUM PHENOMENA IN FLOWING PLASMAS. Final Scientific Report. Eustis, R. H.; Kruger, C. H.; Mitchner, M. (Stanford Univ., Calif. Dept. of Mechanical Engineering). Mar 1973. Contract F44620-68-C-0051. 17p. (AFOSR-TR-73-867). NTIS.

Areas studied include transport coefficients in partially ionized two-temperature plasmas, the effects of nonelastic collisions on the kinetic theory of high temperature gases, ionization rates including nonelastic collision effects, the nonequilibrium boundary layer in flowing plasmas, vibrational interactions in rapidly expanding gases, stability and breakdown phenomena in plasmas flowing through magnetic fields, current distributions and discharge characteristics, and diagnostic techniques. The work is summarized under four broad categories: MHD Generator-Related Experiments, Properties of Nonequilibrium Collision-Dominated Plasmas, Diagnostics, and Nonequilibrium Measurements in Rapidly Expanded Flows. (auth)

28997 (AD-7618000) DENSE PLASMA FOCUS X-RAY EMISSION: STUDIES AND APPLICATION. Mertz, A. R. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Mar 1973. 63p. (GEP/PH-73-15). NTIS.

Thesis.

X-radiation from a region 4.0 to 11.0 mm above the anode of a 33kJ plasma focus device was spectrally (1.0 to 5.0 keV) and temporally resolved. The plasma radiation during the first compression was found to correlate with a thermal plasma bremsstrahlung radiation in the temperature range 0.3 to 0.6 keV in pure deuterium. Additions of 1 to 4% argon and other high-Z gases enhanced the soft continuum and produced intense line radiation about 20 ns after the first compression. Copper–zinc line radiation and continuum resulting from an ejected metallic cloud were produced about 150 ns after the initial compression. The angular photoelectron distribution for oblique, pulsed radiation incident upon a thin foil indicated a peak emission angle of about 30° to about 50° from the axis of incident radiation. (auth)

28998 (AD-762319) RELATION BETWEEN THE RADIATED POWER AND THE RECEIVED POWER DUE TO GYRATING ELECTRONS IN AMBIENT PLASMA. Ko, H. C.; Chuang, C. (Ohio State Univ. Research Foundation, Columbus). 8 May 1973. Contract F19628-70-C-0019. 12p. (AFCRL-TR-73-315). NTIS.

It is shown that the rate of energy radiated per unit of solid angle and frequency interval by a gyrating electron in an ambient magnetoactive plasma is related to the rate of energy received per unit of solid angle and frequency interval by a distant observer. (auth)

28999 (FRNC-TH-393) PENETRATION AND CROSSING OF A TRANSVERSE MAGNETIC FIELD BY A PURELY IONIC PLASMA BEAM. Baribaud, M. (Grenoble Univ. (France)). 1972. 170p. (In French). Dep. NTIS (U. S. Sales Only) $10.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The production of a H^+, H^- plasma was studied in view of investigating its interaction with a transverse magnetic field barrier. The H^- negative ion source developed enabled a particularly dense ($n = 10^{14}$ m^{-3}) beam to be obtained. This beam, which is partially neutralized by crossing a neutral H_2O target, gives rise to the H^+H^- plasma. The beam density does not exceed 10^{12} m^{-3}. Under these conditions the study of the crossing of the barrier has to be limited to the region where $\beta \ll 1$ (β = ratio between the kinetic pressure of the beam and the magnetic pressure). A description is given of the characteristic magnetic field B_0 above which the space charge is no longer sufficient to oppose the complete dissociation of the plasma beam into two beams: a positive ion beam and a negative ion beam. Nevertheless a very small part of the initial beam continues to flow along the axis (residual current). A theoretical study was made of these phenomena using a macroscopic model for an infinite plasma reaching the edge of a sharp-fronted magnetic barrier. The modifications produced by a finite magnetic field gradient and a finite transverse dimension for the plasma were studied using two numerical models: one of the models is an extension of the analytical macroscopic descrip-

tion; the other model is a two-dimensional numerical Lagrangian experiment. These various approaches lead to a coherent description of the phenomena and are in agreement with the experimental results. The effect of the incident plasma density and the width of the barrier crossed were demonstrated. (FR)

29000 (INIS-mf-819) LECTURES ON PLASMA PHYSICS AND PROBLEMS OF CONTROLLED THERMONUCLEAR FUSION. Ivanov, A. A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 127p. INIS.

Various aspects of plasma physics and instabilities in plasma are studied theoretically. Hydromagnetic instabilities in collisionless plasma are studied using Vlasov equations for self-consistent electric and magnetic fields. The Langmuir oscillations, the Bunemaan instability, the electron beams and the ion-beam instabilities in plasma are discussed. A quasi-linear theory of beam instabilities and a kinetic approach to the Landau effect are presented. Mathematical equations of motion for solitons in solid-state plasma and partially ionized plasma are derived. The behavior of plasma as well as that of the waves in plasma in a magnetic field and the drift motion of particles, etc. are explained. A theory of whistlers, which form the most predominant instability of solid-state collision plasma, is put forward with special reference to magnetosonic waves, Alfvén waves, and dielectric tensors. Mention is made of cyclotron heating and the relevant theory developed. Various types of instabilities in partially ionized plasma and their suppression and stabilization by magnetosonic waves are discussed. Relevant uses of the plasma equations in thermonuclear fusion are indicated, and expressions for reaction criteria, etc. are derived. A detailed account of laser-triggered fusion plasma, using the Teller theory, is included. (auth)

29001 (N-72-13678) INVESTIGATION OF TRANSIENT PRESSURE AND PLASMA PROPERTIES IN A PINCHED PLASMA COLUMN. Stover, E. K.; York, T. M. (Pennsylvania State Univ., University Park (USA). Dept. of Aerospace Engineering). Sep 1971. 99p. (NASA-CR-124737; PSU-AERSP-71-4). NTIS.

Thesis.

The transient pinched plasma column generated in a linear z-pinch was studied experimentally and analytically. The plasma column was investigated experimentally with the following plasma diagnostics: a special rapid response pressure transducer, a magnetic field probe, a voltage probe, and discharge luminosity. Axial pressure profiles on the discharge chamber axis were used to identify three characteristic regions of plasma column behavior; they were in temporal sequence: strong axial pressure asymmetry noted early in plasma column lifetime followed by plasma heating in which there is a rapid rise in static pressure and a slight decrease in static pressure before plasma column breakup. Plasma column lifetime was approximately 5 microseconds. The axial pressure asymmetry was attributed to nonsimultaneous pinching of the imploding current sheet along the discharge chamber axis. The rapid heating is attributed in part to viscous effects introduced by radial gradients in the axial streaming velocity. Turbulent heating arising from discharge current excitation of the ion acoustic wave instability is also considered a possible heating mechanism. (auth)

29002 (UCRL-74902) ELECTRON TRANSPORT INTO A TWO-LAYERED SLAB. Thiessen, A. R. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Jul 1973. 5p. (CONF-731009-2). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Good agreement is shown between electron transport calculations by the LLL LASNEX multigroup flux-limited diffusion model and the LASL Monte Carlo model. (auth)

29003 FORMATION OF A PERIODIC WAVE STRUCTURE ON THE DRY SURFACE OF A SOLID BY TEA-CO_2-LASER PULSES. Siegrist, M.; Kaech, G.; Kneubuehl, F. K. (Eidgenoessische Technische Hochschule, Zurich). Appl. Phys.; 2: No. 1, 45-46 (1973).

The formation of periodic wave patterns on surfaces of insulators (e.g., quartz glass) and metals (e.g., Cu) by means of TEA-CO_2-laser pulses was observed. The wavelength of the patterns equals that of the laser radiation. The phenomenon is illustrated by samples of quartz glass and copper. The effect is related to problems of laser-induced fusion. (GE)

29004 SHOCK AND COMPRESSION BY TEA-CO_2-LASER PULSES DRASTICALLY ENHANCED BY LIQUID LAYERS SPREAD ON SURFACES OF SOLIDS. Siegrist, M.; Kneubuehl, F. R. (Eidgenoessische Technische Hochschule, Zurich). Appl. Phys.; 2: No. 1, 43-44(1973).

A drastic enhancement of shock waves and compression in insulators (e.g., quartz) and metals produced by TEA-CO_2-laser pulses is achieved if liquid inorganic and organic layers (e.g., H_2O are spread over the surface. This effect is of interest for laser-induced nuclear fission and fusion. (GE)

29005 STARK BROADENING OF HYDROGEN SPECTRAL LINES IN A PLASMA. Sholin, G. V.; Demura, A. V.; Lisitsa, V. S. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2097-2115(Jun 1973). (In Russian).

The contours of hydrogen lines in a plasma due to static action of ions and electron impacts are considered theoretically. General expressions for impact half-widths of the Stark components of any line of the hydrogen spectrum are obtained by parabolic quantization. A consistent analysis is carried out of the transition from the case of overlap to that of isolation of the Stark components. It is shown that the transition involves cancellation of off-diagonal matrix elements of the impact electron broadening operator and a sharp division of electron collisions into elastic and inelastic collisions. As a result, the interference term in the electron-broadening operator considerably decreases. Agreement between the theory and experiment for lines with strong central components can be improved by taking this phenomenon into account. New formulas for the intensity distribution in the hydrogen line wings are also obtained by a rigorous mathematical procedure. The coefficients R(N,T) for Ly-α, Ly-γ, H_α and H_γ lines are calculated by means of the new wing formulas for various values of the concentration N and plasma temperatures. A detailed analysis is carried out for the Ly-α line and qualitative features of the new formulas for other lines are discussed. (auth)

29006 DYNAMICS OF PLASMA COLUMN CONSTRICTIONS AND ELECTROMAGNETIC ACCELERATION OF IONS. Imshennik, V. S.; Osovets, S. M.; Otroshchenko, I. V. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2057-2071(Jun 1973). (In Russian).

A new attempt is made to explain the old effect of neutron radiation emitted by a rapidly compressing z-pinch. It is suggested that strong electric fields of an inductive nature are produced in the constrictions due to the development of instabilities with a mode m = 0. Magnetohydrodynamic-approximation calculations of constriction development show that the electric-field potential differences are approximately equal to the accelerated ion energies observed in the experiments. A novel feature of the present approach is that plasma flow from the constriction region is taken into account. The effect is calculated by means of a two-dimensional set of MHD equations in which radius profiling of all quantities is employed and which is applicable for description of the cumulative stage of the pinch effect. Due to outflow of the plasma (at the time of maximal overvoltage from 0.1 to 0.01 of the initial number of particles remain in the constriction) the potential difference becomes rather large and the main condition for direct acceleration of ions is fulfilled despite the presence of a transverse magnetic field. On the contrary, the magnetic field impedes electron acceleration. Other possibilities of explaining electron acceleration are discussed, particularly those related to effects that cannot be treated by the hydrodynamic approach but that can explain the appearance of hard x rays. Such rays with quantum energies close to the energies of the accelerated ions are usually observed simultaneously with the neutron radiation. (auth)

29007 INSTABILITY OF TRANSVERSE ELECTROMAGNETIC WAVES IN A DRIFTING ELECTRON-HOLE PLASMA. Balev, O. G.; Boiko, I. I. (Inst. of Semiconductors, Kiev). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2177-2183(Jun 1973). (In Russian).

The dispersion law of low frequency electromagnetic waves propagating along the direction of stationary drift of electrons and holes is investigated for crystals of various geometry (plate and cylinder). The analysis is carried out by taking into account the magnetic field due to the stationary current itself. Instability of an axial-symmetric wave appearing in the absence of an external longitudinal magnetic field is investigated in detail for cylindrical crystals. It is shown that the instability can be observed only if the cylinder radius exceeds a certain critical value. Numerical estimates of the wave increment in the instability region are made for indium antimonide. (auth)

29008 SOFT X-RAY GENERATOR ASSISTED BY LASER. Shatas, R. A.; Roberts, T. G.; Stettler, J. D.; Meyer, H. C. III. US Patent 3,746,860. 17 Jul 1973. Filed date 17 Feb 1972. 8p.

A high-density pulsed plasma generator is disposed in axial alignment with a high-energy pulse laser to receive laser radiation from the laser axially to the movement of the plasma blob along the centerline of the center electrode of the plasma gun. A high-Z material is disposed between the laser output and the plasma for evaporation by the laser and subsequent injection of heavy-Z ions into the plasma for enhancing x radiation from the

plasma. Electrical circuit means is provided for energizing the plasma gun and the laser at predetermined times. (Official Gazette)

29009 ION SAMPLING FROM THE NEGATIVE GLOW PLASMA IN A CYLINDRICAL HOLLOW CATHODE. Howorka, F.; Lindinger, W.; Pahl, M. (Univ., Innsbruck). J. Mass Spectrom. Ion Phys.; 12: No. 1, 67-77(Aug 1973).

A new hollow-cathode design is described that is used for continuous recording of radial density distributions of individual ion species in the negative-glow region of a cylindrical hollow-cathode dc discharge. The ions effuse through a sampling probe of 1-mm diameter, the orifice diameter being 20 to 50 μm. The radial density distributions of individual ion species in the negative glow region may be determined directly from the effusive ion currents i(r) if the probe potential is equal to the space potential. Due to elementary processes in the negative glow region, e.g., ion–molecule reactions, secondary and tertiary ions are formed whose density distributions over the radius differ appreciably from the distribution of primary ions produced by electron impact. The measurement method is the basis of the determination of reaction-rate constants from the radial ion-density distribution in the negative-glow region of a cylindrical hollow-cathode dc discharge. A first evaluation of this method has already been given elsewhere. Further applications of the present measurement method include the recording of the radial field-strength distribution in the transition zone between negative glow and dark space near the glow edge. (auth)

29010 MEASUREMENT OF THE PROBABILITY DISTRIBUTION OF ELECTRIC FIELD FLUCTUATIONS IN A TURBULENT PLASMA. Raether, M.; Yamada, M. (Univ. of Illinois, Urbana). Phys. Lett.; 44A: No. 4, 241-242(18 Jun 1973).

The probability distribution of electric field fluctuations in a stationary turbulent state of unstable ion-acoustic waves was measured. For high instability levels the distribution function is found to be Gaussian. Deviations from the Gaussian shape are observed close to onset of the instability. (auth)

29011 ELECTRON-HEATING RESONANCES IN A PENNING SOURCE. Fuchs, G.; Steyaert, J.; Clark, D. J. Phys. Lett.; 44A: No. 4, 275-276(18 Jun 1973).

The maximum electron temperature in a Penning discharge was determined as a function of the magnetic field. The electron temperature and density were derived from the x-ray emission. A diagram is given. (MOW)

29012 ELECTRON ENERGY DISTRIBUTION AND ELECTRICAL PROPERTIES OF STRIATIONS IN He, H_2, AND N_2. Zaitsev, V. V.; Maksimov, A. I.; Svettsov, V. I. (Ivanovo Chemical-Technological Inst., USSR). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 9, 1517-1521(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1894-1898(Sep 1972).

The electron energy distribution in striations in discharges in helium, hydrogen, and nitrogen at pressures 0.1 to 1 torr and currents 2 to 14 mA were measured at various points of the striation. The field and electron density distributions along the striation and the fraction of energy lost by electrons in inelastic collisions were also determined. The results indicate the predominant role of the striation front in processes associated with the inelastic loss of energy. (auth)

29013 PRODUCTION OF AN INTENSE ELECTRON BEAM. Lagunov, V. M.; Ponomarenko, A. G.; Fominskii, L. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 9, 1560-1567(Mar 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 9, 1947-1957(Sep 1972).

Experimental results are presented on the focusing of an electron beam (~300 keV and 3 kA, and pulse length ~10^{-7} sec), obtained with a field-emission length cathode. The current density is ~10^5 A/cm^2. A method of measuring the beam parameters is described: these include current, electron energy spectrum, the beam configuration in the focusing magnetic field, and the total energy transported by the beam. The effect of the plasma in the accelerating gap on the operation of the vacuum diode and on beam focusing is discussed. (auth)

29014 SCATTERING OF RADIATION BY THERMAL ELECTRONS IN A MAGNETIC FIELD. Gnedin, Yu. N.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 102-116(Jul 1973). (In Russian).

Satellites of the fundamental frequency $\omega \pm n\omega_H$ appear on scattering of radiation by thermal electrons. Compton exchange of energy between the plasma and radiation at $(kT_e/\hbar) > \omega > \omega_H > \Delta\omega_D$ is mainly due to scattering into the satellites, but the energy exchange rate is not altered compared to the case of absence of a magnetic field. A classical and quantum derivation of the satellite intensities is presented. The scattering gives the main contribution to absorption of radiation with $\omega \sim \omega_H$ in the case of low density and weak plasma turbulence. In this case, nonlinear scattering of resonance radiation into the high-frequency harmonics $\omega' \sim n\omega_H$ may be great; this scattering simulates magneto-bremsstrahlung radiation of a hot plasma with $kT_* = m_e v^2/2 = e^2E^2/2m_e(\omega - \omega_H)^2$ despite the fact that the plasma may be cold $T_e \ll T_*$. At a high brightness temperature of the resonance radiation $kT_b > m_e c^2$ and $|\omega - \omega_H| \ll \omega_H$, the electron moves in the field of the wave with a relativistic velocity $eE/m_e|\omega - \omega_H|c > 1$. The presence of a resonance in the scattering cross section at $\omega = \omega_H$ makes feasible the observation of "strong" wave effects when the wave is in fact a "weak" one in the usual sense of the word: $(eE/m_e\omega c) < 1$. At $\omega \ll \omega_H$ the transition of an ordinary wave to an extraordinary one and the converse transition during scattering occurs with a small cross section $\sim\sigma_T(\omega/\omega_H)^2$. (auth)

29015 TWO-LEVEL SYSTEM WITH DAMPING IN A PLASMA. Kogan, V. L; Lisitsa, V. S.; Selidovskin, A. D. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 152-167(Jul 1973). (In Russian).

A theory of inelastic transitions in a two-level system is developed that extends the usual theory in two directions: 1) only one of the levels is considered stationary, whereas the second is assumed to possess a prescribed damping γ; 2) the system is perturbed by the resultant microfield of all surrounding particles. The calculations are performed for the case of dipole interaction with the microfield of charged particles moving along classical linear trajectories. The whole range of perturbing particle velocities can be described in a unified way by the theory. Within this range, five different physical regions can be distinguished: a static, "Weisskopf," adiabatic, "exponential," and Purcell (Born) regions. Only in some of the regions can the lifetime of the stationary (usually metastable) level be expressed in terms of an ordinary cross section for inelastic transitions between stationary levels, whereas in other regions it can be expressed in terms of a kind of "cross section" of a more complex nature (which contain γ) or is not related to any type of cross section at all. The concepts of elasticity and inelasticity and of adiabaticity and nonadiabaticity become "mixed" if allowance is made for $\gamma \neq 0$. The possibility of applying the theory to the problem of destruction of a metastable level in a plasma is discussed. (auth)

29016 POLARIZATION SPECTROSCOPIC ANALYSIS OF NOISE IN A TURBULENT PLASMA PRODUCED ON ANNIHILATION OF OPPOSITELY MOVING MAGNETIC FIELDS. Babykin, M. V.; Zhuzhunashvili, A. I.; Oks, E. A.; Shapkin, V. V.; Sholin, G. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 175-188(Jul 1973). (In Russian).

An optical technique for measuring the direction diagram of electrostatic noise is described that is based on a polarization analysis of the Stark contours of hydrogen spectral lines. The turbulence level of noise arising on annihilation of oppositely moving magnetic fields is measured by aid of the technique, and it is shown that a current instability for electron cyclotron frequency harmonics arises in the plasma. (auth)

29017 TRANSPORT PHENOMENA, 1973. International Centennial Boltzmann Seminar, Providence, Rhode Island, January 22–26, 1973. Kestin, J. (ed.). AIP Conference Proceedings, Number 11. New York; American Institute of Physics (1973). 364p.

Separate abstracts were prepared for three of the fourteen papers. (MOW)

For abstracts of individual papers see: 28206, 29018, and 29019.

29018 TRANSPORT PROPERTIES IN IONIZED GASES. Sandler, S. I. (Univ. of Delaware, Newark). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 11, 203-222(1973).

From international centennial Boltzmann seminar; Providence, RI (22 Jan 1973).

The various problems that arise in predicting the transport properties of dilute, collision-dominated plasmas are reviewed. Particular attention is given to the choice of the kinetic equation for the velocity distribution functions, the collision cross sections needed in the computations, and the convergence of the calculational procedures at various degrees of ionization. The existence of two-temperature (nonequilibrium) plasmas and the effects of external fields are also considered. (auth)

29019 PROJECTIONS AND NEEDS IN RESEARCH AND INDUSTRY: NUCLEAR REACTORS, PLASMAS, AND OTHER TECHNOLOGICAL AREAS. Hurwitz, H. Jr. (General Electric Co., Schenectady, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 11, 315-330(1973).

From international centennial Boltzmann seminar; Providence, RI (22 Jan 1973).

While numerous incompletely solved transport problems can be

cited in currently active fields of applied research and development, the major general needs relate to refinements in the theoretical bases and error characterization of analytic methods. Major delays in technological progress frequently result from failure of experiments and industrial devices to perform as anticipated either because of unjustified theoretical approximations or neglect of crucial transport phenomena. Although large-scale computer calculations are playing a useful role in the interpretation of experiments and in the engineering design process, there remain widespread needs both for improved realism in the computer models and greater efficiency in computer techniques that would enable sophisticated calculational procedures to be more routinely applied. (auth)

Kinetics (Experimental)

29020 (AD-756524) LASER LIGHT ABSORPTION CHARACTERISTICS OF A LASER-PRODUCED HYDROGEN PLASMA. Carlisle, J. A. (Naval Postgraduate School, Monterey, Calif.). Dec 1972. 42p. NTIS.

Thesis.

Light from a neodymium doped glass laser was focused in hydrogen gas at pressures from 20 mtorr to 62 atm in order to produce optical breakdown of the gas. In the cases where breakdown was experienced, absorption of the remainder of the laser pulse by the resulting plasma was studied. It was found that the hydrogen plasma had some very distinct absorption characteristics; in that, absorption was very small at pressures slightly exceeding the threshold for optical breakdown, and very strong at pressures above one atmosphere. There was strong evidence of a frequency shift greater than 35 Å of the laser light as a result of its transit through the plasma. Photographs of the forward transmitted laser intensity pulses after breakdown were compared in time with a similar pulse in which no breakdown was experienced. (auth)

29021 PRODUCTION OF FAST ELECTRONS IN THE BEAM–PLASMA INTERACTION. Conrad, J. R.; Walsh, J. E.; Diaz, C. J.; Freese, K. B. (Dartmouth Coll., Hanover, NH). Phys. Rev. Lett.; 30: No. 18, 827-829(30 Apr 1973).

High-energy electron generation by longitudinal electrostatic waves in a beam–plasma system was observed. A direct correlation was found between the measured field and particle spectra. (auth)

29022 OBSERVATION OF COHERENT CHERENKOV RADIATION FROM PLASMA. Mizumachi, Y. (Hiroshima Univ.); Nishikawa, K.; Nishikawa, T. J. Phys. Soc. Jap.; 34: No. 4, 1083-1088(Apr 1973).

A highly relativistic bunched electron beam accelerated by a linear accelerator is injected into a plasma in the direction parallel to a weak magnetic field. When the plasma frequency is matched to the accelerator frequency (8980 MHz), a strong polarized radiation is observed in the propagation direction perpendicular to the magnetic field. The electric vector of the radiation is perpendicular to the magnetic field and the spectrum is limited to the accelerator frequency. The microwave power received in a horn antenna (0.1 ster.) is about 0.1 μW for a 1-mA beam current. The properties of this radiation are consistently explained by assigning it as the coherent Cherenkov emission of the extraordinary waves. The observed power is lower than the value expected from the theory, but this is possibly due to dissipation of waves in the plasma. (auth)

29023 CONDITIONS OF FORMATION OF A PLASMA-BEAM DISCHARGE (PBD) WITHOUT MAGNETIC FIELD. Popovich, V. P.; Novskova, T. A.; Kharchenko, I. F.; Shustin, E. G. (Inst. of Radiotechnology and Electronics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 7, 1109-1117(1973). (In Russian).

The region of existence of PBD without the magnetic field was studied experimentally at different values of the neutral-gas pressure and of the beam current. The plasma density was found to exceed essentially the electron density of the beam. The spatial distribution of the plasma density and of the intensity of excited hf fields in the discharge were measured. It is shown that, in the system without the magnetic field, PBD may arise due to the instability when the beam interacts with surface waves in the bounded system. The experiments with preliminary beam modulation in a wide range of frequencies show the possibility of controlling the PBD characteristics—the spatial distribution of the plasma density and of the spectra of hf and lf oscillations excited in the system. (auth)

Kinetics (Theoretical)

29024 (AD-753245) ANALYTIC TREATMENT OF THE LINE RADIATION FROM DENSE PLASMAS. Final Report. Wilson, R. N. (Mission Research Corp., Santa Barbara, Calif. (USA)). Dec 1972. Contract DASA01-71-C-0054. 132p. (MRC-R-11; DNA-2956-F). NTIS.

An approximate analytical solution to the nonequilibrium radiation transport equation is obtained for a gaseous slab consisting of ions and electrons. The analytic expression for the spectral flux escaping the slab exhibits line inversion. The analytic results provide a convenient alternative to numerical integration of the transport equation and in addition provide insight about the physical roles of spatial diffusion and frequency diffusion effects in the transport of radiation through optically thick plasmas. The analytic formalism is applied to a semi-infinite slab and the results show the evolution of an inversion line into an absorption line. The problem of radiation incident on a slab is solved, and the results show a peaking of the backscattered spectral flux. Conditions are derived for the onset of induced transparency of a slab to incident radiation. (auth)

29025 (AD-756664) SYNCHROTRON SOURCES. I. Extension of Theory for Small Pitch Angles. Epstein, R. I. (Stanford Univ., Calif. Inst. for Plasma Research). Nov 1972. Contract N00014-67-A-0112-0062. 39p. (SU-IPR-495). NTIS.

Some of the features of synchrotron radiation which occur when relativistic particles move with small pitch angles in a magnetic field are examined. The emission from individual particles is computed; the general properties of the emission from distributions of particles with small pitch angles are discussed; and, finally, the emissivities and degrees of polarization for several specific source models are presented. (auth)

29026 (AD-759571) ABSORPTION AND EMISSION COEFFICIENTS FOR ARGON PLASMAS. Final Report. Liebermann, R. W.; Lowke, J. J. (Westinghouse Research Labs., Pittsburgh, Pa.). Apr 1973. Contract F33615-72-C-1405. 29p. (ARL-73-53). NTIS.

In order to calculate spectral absorptivities of argon as a function of temperature, calculations were made of the composition of argon plasmas for pressures of up to 1000 atmospheres and temperatures of up to 25,000°K. Account is taken of deviations from that of an ideal gas by use of the second virial coefficient, and it is found that the maximum deviation of behavior from that of a perfect gas is 12%. Calculations indicate that equilibrium mole fractions of Ar_2^+ are generally less than 0.001. Computer programs were developed to calculate continuum radiation using the calculated equilibrium composition. Radiation from the continuum produced by electrons combining with doubly ionized atoms is calculated using the quantum defect method. (auth)

29027 (AD-761492) GAS HEATING AND VOLUME RECOMBINATION EFFECTS ON POSITIVE COLUMN EQUILIBRIA. Moore, J. W. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Jun 1973. 77p. (GA/PH-73-2). NTIS.

Thesis.

A three-moment model of the positive column is applied to an axisymmetric rare-gas discharge at a pressure of 35 torr and a tube radius of 1 cm. A three-species fluid is considered. The ions and electrons are considered as perfect fluid is considered. The ions and electrons are considered as perfect fluids, and the background gas is modeled as a viscous, thermally conductive, compressible fluid. The zero'th-order equilibrium equations are solved numerically for a model with gas heating and for a model with both gas heating and volume recombination. The results indicate an electron kinetic temperature gradient due to gas heating along with temperatures of .769 eV at the axis and .497 eV at the wall for a current of 60 mA and a much smaller temperature gradient for lower currents. (auth)

29028 (UCID-16297) LASNEX SIMULATION OF X-RAY GENERATION. Shay, H. D. (California Univ., Livermore. Lawrence Livermore Lab). 24 Jul 1973. Contract W-7405-eng-48. 23p. (CONF-730221-1). Dep. NTIS $3.25.

From DNA conference; Washington, District of Columbia, USA (8 Feb 1973).

The x-ray data of two laser-plasma experiments conducted by Mallozzi, et al. and Mead and Violet are examined in light of numerical simulations performed with the code LASNEX. (auth)

29029 CONTINUUM PLASMA IN LOW REYNOLDS NUMBER HOMOLOGOUS TURBULENT SHEAR FLOW. Marcisz, T. J. Chicago; Univ. of Illinois (1973). 160p. University Microfilms Order No. 73-20,042.

Thesis (Ph. D.).

The turbulence structure of weakly ionized, continuum plasma in homologous shear flow is analyzed with emphasis on the turbulent transport and the mean square fluctuation properties of the ionized species. The mean gradients of the velocity and the ionized specie number density are considered to be uniform and it is assumed that the turbulence Reynolds number is small and the turbulence field is locally homogeneous in order to effect closure of the dynamic equations of turbulence. Spectral functions of the two-point plasma correlations are obtained for various values of the ratio of the Debye shielding length to integral scale of turbulence, mean velocity gradient and ionized specie mean number density gradient. Integration of the plasma spectral functions over all wave vectors (eddy sizes) yields the one-point plasma correlations which are interpreted as the turbulent transport of the ionized species and the ionized specie mean-square number density fluctuations. The statistical behavior of the ions and the electrons is found to be insensitive to applied electric field, and the statistical behavior of the electrons is found to approach that of the ions for increasing values of the ionized specie mean number density gradient and for increasing mean velocity gradient. However, the condition of detailed quasi neutrality, wherein the ratio of Debye shielding length to integral scale of turbulence is sufficiently small, is found to be necessary in addition to that of equal mean concentrations of electrons and ions in order that the turbulence properties involving the electrons be the same as those involving the ions. The one-point plasma correlations show total electron transport in a turbulent field to remain virtually unchanged from the laminar value for all values of the Debye shielding length ratio. Turbulent ion transport in the limit of detailed quasi neutrality is less than that of the neutral species in contrast to the laminar case. The effect of increasing the initial turbulence energy, the integral scale of turbulence or the ionized specie mean number density gradient is that of increasing the turbulent ionized specie transport and the mean-square number density fluctuations. This analysis when extrapolated to high Reynolds number boundary layers indicates that the ratio of the saturation electron to ion current ratio may decrease by an order of magnitude as compared to the laminar case. (Diss. Abstr. Int., B)

29030 ONE-DIMENSIONAL MOTION OF A LOW-DENSITY PLASMA IN A MAGNETIC FIELD. Gurevich, A. V.; Pariiskaya, L. V.; Pitaevskii, L. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2126-2139(Jun 1973). (In Russian).

A kinetic equation is derived that describes the drift motion of a collisionless plasma in a magnetic field. Its solution for the case of flow of a plasma into vacuum is investigated. It is shown that discontinuities are formed in a quasi-neutral flow. The oscillatory structure of a weak discontinuity is determined. (auth)

29031 COMPUTATION OF FOURIER INTEGRALS OF EXPONENTIALS OF TRUNCATED FOURIER SERIES. Thomas, J. D.; Lewis, H. R.; Melendez, K. J. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 12: No. 4, 462-470(Aug 1973).

An efficient and accurate method is described for computing a class of definite integrals that have arisen in plasma physics and that arise in the theory of frequency-modulated radio transmission. (auth)

29032 EFFECT OF ELECTRON-ELECTRON COLLISIONS ON THE THERMAL CONDUCTIVITY OF A DENSE PLASMA. Osada, J.; Bonilha, J. R. M.; Ferreira, A. C.; Capelato, H. V. (Univ., Sao Paulo, Brazil). Rev. Brasil. Fis.; 2: No. 2, 95-99 (Aug 1972).

The effect of electron-electron collisions on thermal conductivity of a degenerate plasma is calculated by the perturbation method. Because of this effect, the conductivity is considerably reduced. In the case of a highly degenerate plasma, this effect becomes predominant and the usual formula, which is obtained by taking into account only the effect of ion-electron collisions, becomes useless. (auth)

29033 BREMSSTRAHLUNG OF DEBYE PLASMA. Kvasnica, J. (Charles Univ., Prague). Czech. J. Phys.; 23: No. 9, 888-891 (1973).

The effect of Debye screening on the bremsstrahlung spectrum and total bremsstrahlung intensity of plasma is calculated. As compared with the Coulomb field approximation (infinitely large Debye radius L) an additional density and temperature dependence of the radiation intensity is found. Results are expressed in terms of a dimensionless parameter $\mu = \hbar^2/2mL^2kT$, where m is the rest mass of an electron and other symbols have their standard meaning. Deviations from the Coulomb field approximation become significant for the values $\mu \gtrsim 10^{-3}$. (auth)

29034 CONNECTION BETWEEN THE CONTINUUM EIGENFUNCTIONS AND THE DISPERSION FUNCTION OF THE VLASOV OPERATOR. Sedlacek, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 23: No. 8, 892-907(1973).

It is shown that a function may be extracted from the continuum eigenmode of the Vlasov operator that is related to the boundary values of the dispersion function on the real axis of the complex frequency plane. The precise content and possible consequences of this relationship are investigated in detail, especially the possibility of reconstructing the dispersion function and establishing stability criteria. (auth)

Production

29035 (AD-748260) INVESTIGATION OF OPTIMUM CONDITIONS FOR LASER-PLASMA PRODUCTION AND HEATING FROM SOLID DEUTERIUM DROPLETS FOR INERTIALLY CONFINED PLASMA POWER GENERATION. Final Report, 1 March 1967-29 February 1972. Lubin, M. J.; Sources, J. M.; Goldman, E. B.; Bristow, T. C.; Leising, W. 3 Apr 1972. 43p. (AFOSR-TR-72-1701). NTIS.

Theoretical and experimental work is reported on the vaporization and heating of spherical overdense plasmas. Details of the required laser optics are described, together with charged particle, x-ray, and neutron diagnostics. A series of numerical experiments were conducted to investigate the dynamics and neutron production in dense spherically symmetric plasmas. These have led to a development of scalings for energy absorption, shock strength, and optimum neutron production. Similar numerical work was also used to study the conversion of input laser radiation to output soft x rays from an oxygen-doped spherical laser plasma. The fast risetime of the calculated spectra suggests a method of producing a population inversion. An example is given of a breakeven configuration not requiring anomalous absorption. (auth)

29036 (AD-762418) TRITON: AN EXPERIMENT FOR STUDYING THE INTERACTION OF AN INTENSE RELATIVISTIC ELECTRON BEAM WITH A PLASMA. Goldenbaum, G. C. (Naval Research Lab., Washington, D. C.). Apr 1973. 39p. (NRL-MR-2586). NTIS.

The TRITON experiment for the study of plasma heating by intense, relativistic electron beams is described. A 1.2-MV beam of 150-kA electrons is injected into a 4-m-long theta pinch. The rationale for the design of this experiment is discussed in terms of the existing theory of the intense beam-plasma interaction. (auth)

29037 (CEA-R-4445) INTERACTION OF A LASER-PRODUCED PLASMA WITH AN INTENSE MAGNETIC FIELD. Colombant, D.; Nguyen Trong Thuc; Raguideau, J. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Aug 1973. 52p. (In French). Dep. NTIS (U.S. Sales Only) $4.75.

The expansion of a plasma produced from a solid pellet in a magnetic field and then the compression of an already produced plasma by a magnetic field are studied. In the first case, an absorption model has been introduced which takes into account the main features of much more sophisticated models without, however, setting any constraints on the computation time. The mathematical model as well as the numerical method used are detailed. Results are then presented for both problems considered. The limits of the different models are outlined in a final part. (auth)

29038 (EUR-CEA-FC-693) LASER-INDUCED GAS BREAKDOWN. de Michelis, C. (Commissariat a l'Energie Atomique, Fontenay-axu-Roses (France). Centre d'Etudes Nucleaires). May 1973. 106p. Dep. NTIS (U.S. Sales Only) $7.50.

The lecture is divided into three sections. In the first section the ionization mechanism is discussed. Multiphoton ionization and electron cascade ionization theories are exposed and compared with the experimental results. A brief discussion on the origin of the first electrons is also included. In the second section the plasma expansion mechanism and the plasma properties are examined. In the last section a discussion of plasma decay and recombination is provided. (FR)

29039 (FRNC-TH-392 MECHANISM INVOLVED IN THE SYNTHESIS OF A PLASMA BY NEUTRALIZING A SUPERSONIC ION BEAM WITH THERMAL ELECTRONS. Pomot, C. (Grenoble Univ. (France)). 1972. 132p. (In French). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

A macroscopic study was effected on the neutralization of a beam of fast ions by the thermionic injection of electrons. It is shown that this neutralization can only be performed immediately downstream with respect to the neutralizer with the formation of a

sheath in which the electric field is self-regulating. This sheath enables the electrons to acquire the necessary velocity, compatible with a stable periodic solution downstream. An average neutralization occurs. The neutralization of a beam of fast protons by the injection of electrons emitted from an immersed cathode was then experimentally studied. It was shown that a fine neutralization can be achieved by suitably adjusting particular parameters and that the beam downstream from the neutralizer is the origin of a stationary macroscopic and periodic electric field having characteristics similar to those deduced from macroscopic theory, but whose amplitude decreases rapidly with distance. Computer simulation of the neutralization processes demonstrated that an oscillating electric field ω_p is generated in the beam front. This field results in the trapping of electrons in the stationary periodic electric field that develops upstream. Between the sheath and the front, a region occurs whose extent develops with the velocity of the ions and in which a large-amplitude stationary periodic wave of the Bernstein–Green–Kruskal type exists. A microscopic study was effected of the attenuation processes affecting such a wave in a synthesized plasma. The trapped particles lead to instabilities due to interactions between trapped and passing particles, the instabilities manifesting themselves by the appearance of diffusion coefficients in phase space. It is thus possible to qualitatively explain the wave-attenuation processes due to a noncollisional dissipative effect. The synthesized plasma thus becomes more finely neutralized as a result of the presence of fluctuating fields. (FR)

29040 (UCRL-74903) CALCULATIONS OF A SPHERICAL SHELL OF DT IRRADIATED BY 10.6-μ LASER LIGHT. Thiessen, A. R. (California Univ., Livermore. Lawrence Livermore Lab.). 7p. (CONF-731009-3). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

LLL calculation of CO_2 imploded pellets reported by LASL show failure due to electron preheat and decoupling even though optimistic Maxwellian spectra were assumed. (auth)

29041 UTILIZATION OF LASERS IN CONTROLLED THERMONUCLEAR FUSION. Basov, N.; Krokhine, O. (Lebedev Inst. of Physics, Moscow). Energ. Nucl. (Paris); 15: No. 2, 121-125 (Mar 1973). (In French).

It was shown how the action of a high-power laser pulse on a solid target containing a high density of heavy hydrogen atoms (deuterium or tritium) leads to the formation of a high-temperature brief-duration plasma, and how this property might be used for energy production when more efficient lasers become available and when a thermonuclear chain reaction becomes feasible using this method. The characteristics of high-power lasers are recalled together with the various laser radiation absorption effects exhibited by matter. A type of experiment in which nuclear-fusion reactions are produced inside a plasma is presented. The law governing the behavior of the neutron flux as a function of laser energy establishes an upper limit to the temperature increase achievable. (FR)

29042 GAS PLASMA DEVICE. Osborn, H. B. Jr. (to Park Ohio Industries, Inc.). US Patent 3,755,710. 28 Aug 1973. Filed date 24 Mar 1972. 6p.

A method and device is disclosed for ionizing gas at the plasma level thereof and comprises a gas chamber having an inlet for gas to be ionized and which inlet is connected to a source of gas so that the chamber can be filled and the gas maintained therein under a vacuum. An induction heating coil surrounds the chamber and the opposite ends of the coil are connected to a source of alternating current for energizing the coil to establish a magnetic field through the chamber. Flux concentrating laminations in the form of C-shaped plates of magnetic material surround the outer and axially opposite sides of the convolutions of the coil to increase the density of the flux field through the chamber to enhance maintenance of gas ionization. (Official Gazette)

29043 INVESTIGATION OF AN RF PRODUCED NONNEUTRAL HOT ELECTRON PLASMA. Luhmann, N. C. College Park, MD; Univ. of Maryland (1973). 243p. University Microfilms Order No. 73-18,740.

Thesis (Ph.D.).

To investigate the properties of an rf produced, magnetically confined nonneutral hot electron plasma, a low energy (~1 keV), low current (~0.06 A) electron beam was injected along the axis of an evacuated right circular cylindrical cavity resonator situated in an axial magnetic mirror field ($B \sim 314$ G, Rm = 1.3), was excited in the TE_{111} mode with up to 15 kW of rf power at 0.88 GHz. This scheme produces a hot electron nonneutral (for ~10 to 200 msec) plasma ($W_e \sim 100$ keV, $N_e \sim 4 \times 10^{11}$ electrons, $n_e \sim 4 \times 10^9$ cm^{-3}) with a lifetime of up to 10 sec. Peak energy gains of 240 keV are realized when this device is operated in an accelerator mode for which the magnetic field is homogeneous. In order to investigate the motion of electrons in the large amplitude fields of this cavity, the relativistic (neglecting the radiation reaction force) single particle equations of motion were integrated numerically for the cases of a cavity resonator immersed in a uniform magnetic field, a magnetic mirror field, and combined mirror–quadrupole magnetic field. The single particle predictions pertaining to particle energy, optimum magnetic field strength, etc., were in reasonable agreement with experiment (uniform magnetic field and mirror field). The magnetically confined nonneutral hot electron plasma emits coherent radiation caused by phase bunching and synchronous interactions with the TE cavity resonances. For low numbers of trapped electrons the emitted radiation is localized near a single cyclotron frequency and its harmonics. As the number of trapped electrons increases, there is a spread of the distribution of radiation near these frequencies. A ∇B precessional motion of the entire nonneutral hot electron plasma produces a periodic low frequency signal (several MHz) in an induced current electrostatic probe. This collective motion induces a gradual spiralling outward that ultimately results in plasma destruction by collision with the wall. The time at which the plasma strikes the wall depends on the background gas pressure; at $\sim 2 \times 10^{-5}$ torr the plasma reaches the wall in ~50 – 150 μsec, but at normal operating pressure ($\lesssim 5 \times 10^{-6}$ torr) collision with the wall is not observed. The similarities of the nonneutral plasma produced by rf cyclotron heating and a nonneutral plasma produced by adiabatic magnetic compression of an electron beam are discussed. (Diss. Abstr. Int., B)

Stability

29044 (LA-UR-73-1123) LASER-INDUCED INSTABILITIES AND ANOMALOUS ABSORPTION IN DENSE PLASMAS. DuBois, D. F. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-405-eng-36. 25p. (CONF-730836-1). Dep. NTIS $3.25.

From third workshop on laser interaction and related plasma phenomena; Troy, New York, USA (13 Aug 1973).

The nonlinear and linear theory of parametric instabilities in laser-produced plasmas is given for both the homogeneous and inhomogeneous cases. (MOW)

29045 (UCRL-73951) RELATIVISTIC BEAM PLASMA INSTABILITY IN STRONG MAGNETIC FIELD. Berk, H. L. (California Univ., Livermore. Lawrence Livermore Lab.). 22 May 1972. 14p. Dep. NTIS $3.00.

Stability criteria for a weak relativistic beam–plasma interaction in a strong magnetic field are found. Two beam modes occur, $\omega \doteq k_z c$ and $\omega \doteq k_z c - \omega_c$, where ω_c is the relativistic cyclotron frequency. The former mode is insensitive to thermal spread, but is stabilized if the beam thickness, L_p, is sufficiently small, viz. $L_p < (\pi\gamma c/\omega_p)\mathrm{Min}[1, \frac{1}{2}(n_c/\gamma n_b)^{\frac{1}{3}}]$, where γ is the usual relativistic parameter and n_c and n_b are the background and beam densities, respectively. The latter mode is sensitive to thermal spread in γ, and stable regimes are found when the background collision frequency and the beam thermal spread are sufficiently large. These modes require a complete electromagnetic analysis over much of the parameter range of interest. (auth)

29046 ELECTRON-SOUND AND DRIFT INSTABILITY IN A FINITE PRESSURE PLASMA WITH A TRANSVERSE CURRENT. Gudblud, I. P.; Pyatak, A. I.; Sizonenko, V. L. (Physical Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2084-2096 (Jun 1973). (In Russian).

Nonpotential instabilities induced by a current flowing perpendicular to an external magnetic field in a finite-pressure ($\frac{1}{2}\pi n_e T \sim H^2$) plasma with the hot ions and cold electrons are investigated. Expressions for the frequencies and increments of the unstable oscillations are obtained. The level of turbulent electric-field pulsations under saturation conditions is estimated. Estimates are obtained of the turbulent friction and the rate of increase of the temperature of ions scattered by turbulent electric field noises. (auth)

29047 NONLINEAR ION SURFACE OSCILLATIONS IN A SEMI-RESTRICTED CURRENT-CARRYING PLASMA. Abu-Asali, E.; Al'terkop, B. A.; Dzhamalov, R. D.; Rukhadze, A. A. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2051-2056 (Jun 1973). (In Russian).

Nonlinear theory of instability of ion-acoustic oscillations of a nonisothermal ($T_e \gg T_i$) plasma with a current is developed. The excitation threshold for shortwave surface waves is lower than that for volume waves. It is shown that under single-mode conditions, the major mechanism restricting growth of the unstable wave amplitude is nonlinear shift of its frequency. The frequency and amplitude of a stationary nonlinear wave are found near the instability threshold. (auth)

29048 AMPLITUDE SATURATION OF DRIFT WAVES IN A Q-MACHINE. Kraybill, D. M. Urbana, IL; Univ. of Illinois (1972). 165p. University Microfilms Order No. 73-17,288.

Thesis (Ph.D.).

The linear and nonlinear properties of the density-gradient driven drift wave instability are studied in a single-ended Q-machine in which the drift waves occur at a radius far from the origin $[-(r/n)(dn/dr) \gg 1]$ due to the particular density gradient resulting from an aperture limiter. The drift wave is observed under both collisionless and collision-dominated conditions. Agreement is noted in many respects with the predictions of slab model calculations, but effects are observed which indicate that the nonuniform radial electric field which also occurs near the aperture radius cannot be neglected in an accurate theory. The collisionless drift wave is observed at densities from 9×10^8 cm^{-3} to 1×10^9 cm^{-3}. The spectral properties, spatial distribution, and stability properties are measured and compared with the predictions of linear theory. Observations of mode–mode coupling effects between drift wave modes and between the drift wave and another low frequency instability are described. The behavior of the saturation amplitude shows points of agreement with a theory describing a particle–wave scattering mechanism for limiting the wave amplitude, but a magnetic field dependence is noted which is not predicted by the theory. The collisional drift wave is observed at densities from about 5×10^8 cm^{-3} to 4×10^{11} cm^{-3}. The linear growth rate of the m = 2 mode is measured. Comparison with theory indicates that the contribution of the radial electric field to the growth rate is comparable to the basic finite ion inertia growth mechanism. The observed relationship between the linear growth rate and the saturation amplitude is found to be in agreement with a theory describing the combined effects of ion lifetime damping and reduction of the density gradient by wave-induced particle diffusion as the nonlinear mechanism responsible for limiting the wave amplitude. (Diss. Abstr. Int., B)

29049 MAGNETOGRAVITATIONAL INSTABILITY OF A VISCOUS PLASMA WITH UNIFORM ANGULAR MOMENTUM AND HALL CURRENT. The Dispersion Relation. I. Vasiu, M. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys.; 18: No. 1, 61-67 (1973). (In French).

The dispersion relation for an infinite, homogeneous compressible, viscous plasma, with uniform angular momentum, finite electric conductivity, and anisotropic pressure is given. Plasma is considered in a uniform axial magnetic field and in its own gravitational field. The thermal conductivity and the radiation transfer inside the plasma are neglected. The obtained dispersion relation generalizes the dispersion relations given by other authors for the case, neglecting viscosity, electric conductivity, and plasma angular momentum. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 28376 and 28612.

29050 (LA-UR-73-1396) HIGH-ENERGY, SHORT-PULSE GAS LASER SYSTEMS. Fenstermacher, C. (Los Alamos Scientific Lab., N. Mex.). 1973. 38p. Dep. NTIS $4.00.

The status of high-pressure CO_2 lasers is discussed in detail and compared with other high-energy short-pulse laser systems. The discussion is divided into three areas: (1) pumping mechanisms, (2) short pulse generation by the oscillator, and (3) the extraction of stored energy from the amplifier stages by short pulse amplification. (MOW)

29051 (ORNL-TM-4208) CROSS-SECTION SENSITIVITY OF BREEDING RATIO IN A FUSION-REACTOR BLANKET. Bartine, D. B.; Alsmiller, R. G. Jr.; Oblow, E. M.; Mynatt, F. R. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 78p. Dep. NTIS $6.00.

For a particular fusion-reactor-blanket configuration, the changes in the tritium breeding ratio, i.e., in the number of tritium nuclei produced in the blanket per incident neutron, due to changes in nuclear cross-section data are calculated on the basis of linear perturbation theory. Results are presented for the changes in the breeding ratio due to changes in specific energy ranges of various partial cross sections of ^{6}Li, ^{7}Li, Nb, and C. The breeding ratio is found to be most sensitive to changes in the ^{7}Li(n,n′)α,t cross section, but the sensitivity to changes in this cross section is not large. (auth)

29052 (UCID-16279) TWO ELECTRONIC DEVICES FOR THE DIRECT CONVERSION TEST STAND. Smith, R. R. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Jun 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

A test facility is being built that will investigate a direct conversion scheme. Devices have been built to measure nanoampere currents floating up to 1000 V above ground, and to monitor the input beam power to the expander. (auth)

29053 (UCRL-51434) SELECTIVE LEAKAGE OF CHARGED PARTICLES IN MIRROR MACHINES. Carlson, G. A. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Jul 1973. Contract W-7405-eng-48. 24p. Dep. NTIS $4.00.

The achievable efficiency of selective leakage of charged particles in mirror machines is investigated. The purpose of selective leakage (charged particle leakage at only one mirror or leakage at a restricted area of one mirror) is to reduce the size and cost of direct conversion equipment. Selective leakage at a restricted area of one mirror can be accomplished by providing a region in one mirror which has a local minimum in field strength. If the local minimum region intersects all plasma drift surfaces, then the precession of particles about the mirror machine axis ensures that all particles will periodically sample the local minimum. The dominance of small-angle scattering will cause preferential leakage at the location of the local minimum. The achievable efficiency of this selective leakage is limited by single large-angle scatters into the strong-mirror-region loss cone and by cumulative small-angle scatters into the strong-mirror-region loss cone between consecutive samplings of the local minimum. Both losses are functions of the weak mirror ratio (the confinement mirror ratio) and the ratio of the strong to weak mirror ratio. In addition, the small-angle scattering loss is a function of the precession rate of the particles around their drift surfaces. Numerical examples reveal a wide range of efficiency. Efficiencies as high as 98% may be possible but only with a very deep local minimum ($R_{strong}/R_{weak} \simeq 1.5$). Such a local minimum would probably be prohibitively expensive in terms of magnet costs. Efficiencies in the range of 90 to 95% appear to be possible with R_{strong}/R_{weak} in the more reasonable range of 1.1 to 1.2, especially if electrostatic stoppering can be used to further increase the effective strong mirror ratio. (auth)

29054 (UCRL-74345(Rev. 1)) LASER INDUCED IMPLOSION AND THERMONUCLEAR BURN. Nuckolls, J. H. (California Univ., Livermore. Lawrence Livermore Lab). 23 Jul 1973. 23p. (CONF-730836-2). Dep. NTIS $3.25.

From third workshop on laser interaction and related plasma phenomena; Troy, New York, USA (13 Aug 1973).

The following areas related to laser implosion are discussed: (1) thermonuclear burn, (2) implosion, (3) symmetry, (4) stability, (5) computer calculations, and (6) CTR applications. (MOW)

29055 (UCRL-74901) THERMONUCLEAR PROPAGATION AND ELECTRON DEGENERACY IN LASER IMPLOSION CTR. Nuckolls, J.; Thiessen, A. R. (California Univ., Livermore. Lawrence Livermore Lab). 24 Jul 1973. 8p. (CONF-731009-1). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

For controlled thermonuclear reactor (CTR) applications, the fuel gain (ratio of fusion energy produced to fuel energy at ignition) must be greater than 1000 fold—ten times larger than can be achieved with uniformly ignited, nondegenerate fusion micropellets. Gains greater than 1000 fold may be achieved if thermonuclear propagation and electron degeneracy are exploited. (auth)

29056 (WASH-1267) FUSION POWER: RESEARCH AND DEVELOPMENT REQUIREMENTS. (Division of Controlled Thermonuclear Research (AEC), Washington, D. C.). Jul 1973. 57p. GPO $0.90.

The present task in fusion research is to further develop understanding of the plasma state and to prepare to move to the new experiments aimed at obtaining the full combination of temperature, density, and confinement time needed to experimentally demonstrate fusion scientific feasibility. Four general approaches are now receiving major emphasis. These are steady-state toroidal systems (principally the tokamak), magnetic mirror systems, pulsed high-beta pinch systems (principally the theta pinch), and laser-fusion systems. Based upon preliminary systems studies, each of these concepts appears to have the potential of being extrapolated to a practical power reactor. In addition to these main lines, supporting research is carried out that spans a broad range from basic plasma studies to relatively large-scale confinement system research. A significant amount of technological development (magnets, beams, energy storage, lasers, etc.) is conducted in support of existing experiments and in preparation for next-generation systems. Finally, a small but growing program in fusion-reactor analysis and technology is supported both to provide guidance to the plasma research and to provide an understanding of related problems that must be solved prior to the achievement of practical fusion power. (auth)

29057 POSSIBILITY OF USING A SYSTEM OF SLOPED DIAPHRAGMS FOR RECOVERY OF REACTOR ION BEAMS. Vinogradova, O. A.;.Dimitrov, S. K.; Zhitlukhin, A. M.; Igritskii, A. N.; Smirnov, V. M.; Tel'kovskii, V. G. At. Energ. (USSR); 35: No. 1, 15-18(Jul 1973). (In Russian).

It is shown that systems of electrostatic recovery (a system of periodic potential distribution proposed by Post and a system of "sloped" diaphragms) without neutralizing space charge, may reach high efficiency only for a sufficiently small ratio d/n_{di} the incoming beam diameter d to Debye radius n_{di}, calculated from the longitudinal energy of the incoming beam. For Post's reactor conditions, the ratio is 0.18. Post's system and the one proposed by the present authors (a system of "sloped" diaphragms (SSD) with beam focusing at the input) have an estimated efficiency $\eta_{PS} = 73\%$ and $\eta_{SSD} = 90\%$, respectively, for a divergence angle ± 0.02 rad. The experiments showed that for values of d/n_{di} less than those of the reactor, η_{SSD} is much higher than η_{PS} even without preliminary focusing ($\eta_{PS} = 83\%$, $\eta_{SSD} = 96\%$). Moreover, about 5 to 7% of the particles are reflected back into the PS system in the energy interval W/2 to W. No ions are reflected back in the SSD system. Numerical modeling with calculated ion trajectories in the SSD in the case of significant space-charge effect showed that it is possible to obtain an efficiency of 90% and higher by means of preliminary beam focusing (in the absence of transverse energy recovery). Computer calculations also show that it is possible to achieve the required focusing. An unused SSD reserve remains the recovery of transverse energy, reducing losses in the system by a factor of almost two, according to theoretical estimates. (auth)

29058 LOW-POWER REACTOR BASED ON TOKAMAK. Pistunovich, V. I. At. Energ. (USSR); 35: No. 1, 11-14(Jul 1973). (In Russian).

The feasibility of constructing a low-power reactor based on Tokamak with injection of fast deuterium atoms is considered. A thermonuclear reaction occurs when a fast deuteron is slowed down in tritium plasma. The conditions for net electrical-power generation are obtained. (auth)

29059 PLANAR ELECTRODE NEUTRON TUBE. Eschard, G.; Mahieux, G.; Sarrailh, A. (to Laboratoires d'Electronique et de Physique Appliquee). French Patent 2,138,256. 21 May 1971. 5p. (In French).

A planar electrode neutron tube is presented. It consists of a planar anode and a planar cathode positioned, respectively along parallel planes and contained in a vessel filled with deuterium. The facing surfaces of the anode and cathode are equal. (FR)

29060 ELECTRICAL WAVE PUMPED PULSED LASER. Pettipiece, K. J. (to United States Atomic Energy Commission). US Patent 3,753,152. 14 Aug 1973. Filed Date 2 Feb 1972. 10p.

A pulsed laser is described wherein emission is generated from a gaseous gain medium, the gain medium being pumped by at least one traveling high-voltage electromagnetic pulse having a duration too short for inducing formation of an ionization discharge in the medium. The gaseous gain medium is contained in a vessel having a pair of conductors that provide a waveguide for conducting the electromagnetic pulse through the gaseous gain medium. Pulsed laser emission is obtained in an oscillatory mode or in an amplification mode. (Official Gazette)

29061 PULSED HIGH-BETA FUSION REACTOR. Ribe, F. L.; Burnett, S. C.; Ellis, W. R. (to United States Atomic Energy Commission). U. S. Patent 3,748,226. 24 Jul 1973. Filed Date 18 May 1972. 10p.

A fusion reactor in which the thermonuclear plasma is produced by a staged theta pinch having two distinct energy sources, one for shock heating and one for adiabatic compression is described. In the reactor core the plasma is surrounded by a thin liquid-metal-cooled vacuum wall, which also serves as a shock heating coil. This coil is driven by high-voltage circuits whose energy content is only a few percent of that of the total system. The low-voltage compressional and confining magnetic field, whose energy is preponderant, has a risetime of a few milliseconds and is generated by a multiturn coil whose radius is substantially greater than that of the shock-heating coil. The compression coil operates near room temperature, and the system is sufficiently economical of joule losses that they can largely be made up by direct energy conversion from the expansion of the high-beta plasma against the magnetic field during the burning pulse. The compression coil is protected from excessive nuclear radiation and heating by a portion of the neutron-moderating, tritium-breeding blanket. This inner portion of the blanket operates at a temperature as high as about 800°C. Magnetic energy is switched reversibly into the compression coil from a cryogenic magnetic energy store situated outside the reactor core. The compression magnetic energy is returned to the store at the end of each power pulse, which lasts approximately 100 msec. These pulses are separated by times of the order of a few sec. Refueling and flushing of the spent plasma between burning pulses are accomplished by flowing D–T gas through the vacuum chamber. (Official Gazette)

29062 GAS LASER HAVING EXCITATION CHAMBERS WITH MULTIPLE CHANNELS. Gilson, V. A. (to United States Atomic Energy Commission). U. S. Patent 3,750,047. 31 Jul 1973. Filed Date 25 Aug 1972. 6p.

The gas laser excitation apparatus described includes means for providing an axial magnetic field and a plurality of electrodes within the laser cavity defining multiple axially adjacent excitation chambers or sections. Each excitation chamber or section is formed by two spaced parallel annular cathodes of equal radius with a coaxial tubular anode between, each cathode being provided with a plurality of apertures. Successive chambers may share common cathodes so that the apparatus has alternately spaced cathodes and anodes. A potential difference applied between the anodes and cathodes causes electrons to make spiraling paths and undergo high-frequency oscillations along axial magnetic field lines, causing comparatively long electron lifetimes within each chamber, thereby increasing the probability of exciting particles contained therein. The plurality of apertures in the cathodes are aligned, allowing a corresponding number of light beams to pass through annular channels of the excitation chambers where most gas particles in an excited state appropriate for lasing are present, thereby producing a physically short but effectively long tube. (Official Gazette)

29063 HIGH INTENSITY NEUTRON SOURCE. Hilton, J. L.; Hamilton, G. W. (to United States Atomic Energy Commission). U. S. Patent 3,746,859. 17 Jul 1973. Filed date 22 Apr 1970. 8p.

Disclosed is a neutron generator in which a gas (such as a heavy isotope of hydrogen) or a mixture of gases, is ionized by any convenient means such as exposure to a magnetically stabilized arc. The ions are directed to an accelerator and the resulting high-velocity ion stream is caused to impinge on a target. The interaction of the ion beam with the target material soon builds up a high density of gas in the target surface which, in turn, interacts with the incoming beam to produce an intense isotropic neutron output from the fusion of the isotopes. (Official Gazette)

29064 POWER FROM LASER-INITIATED NUCLEAR FUSION. Boyer, K. (Los Alamos Scientific Lab., NM). Astronaut. Aeronaut.; 11: No. 8, 44-49(Aug 1973).

Design studies are described that aim at a 10-kJ module that could provide the basis for a 100-kJ CO_2 laser system. Although several interminable sources of power such as solar and geothermal energy are under investigation, the fusion process seems most likely to meet all practical, economical, and environmental requirements. Two versions of fusion-power generation drive this field: magnetic-confinement and laser-pellet concepts. Recent and coming developments are described for laser fusion and it is foreseen that with even pacing of experimental successes of laser-initiated nuclear fusion, commercial electric power could be produced at economically competitive prices before the 90's. (MCW)

Wave Phenomena

29065 (AD-754904) ELECTROMAGNETIC INTERACTIONS WITH PLASMAS AND TURBULENT MEDIA. Final Report, 30 October 1967–30 September 1972. Collin, R. E. (Case Western Reserve Univ., Cleveland, Ohio (USA). Div. of Electrical Engineering and Applied Physics). 25 Oct 1972. Contract F19628-68-C-0088. 58p. (AFCRL-72-658). NTIS.

A summary is presented of work done on propagation through a turbulent plasma sheath. The Green's dyadic for a warm plasma sheath is presented along with its adjointness and reciprocal properties. The coherence tensor for the electric field transmitted through the sheath is given for the case of a plane wave incident on the sheath and using the Born approximation. It is shown that for the typical plasma parameters encountered during reentry that a cold plasma model is adequate to describe the noise induced due to turbulence. (auth)

29066 (AD-760794) PARAMETRIC EXCITATION OF ION-ACOUSTIC WAVES IN A FULLY IONIZED, BOUNDED PLASMA. Ohe, T.; Abrams, R. H. Jr.; Lashinsky, H. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Apr 1973. 38p. (AFOSR-TR-73-914). NTIS.

Parametric excitation of ion-acoustic waves in the fully ionized bounded plasma in a Q-machine is demonstrated by periodic variation of the electron temperature. The electron temperature is controlled by nonresonant rf heating, the periodic variation of the

electron temperature being achieved by amplitude modulation of the rf power. A model based on the ion-acoustic wave equation for the bounded geometry and the Mathieu equation with appropriate nonlinear terms is found to be in agreement with experimental results such as growth rates, amplitude saturation, phase effects, threshold values, and symmetry properties of the resonance curves. (auth)

29067 (CSIRO-Trans-11352) INFLUENCE OF COLLISIONS AND RELATIVISTIC EFFECTS ON THE PROPAGATION OF HIGH-FREQUENCY WAVES IN MAGNETOACTIVE PLASMA. Krupina, A. E. Translated by G. Losonci from Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 14: No. 6, 817-22(1971). 7p. Dep. NTIS (U. S. Sales Only) $3.00.

Propagation of electromagnetic waves in plasma near the electron cyclotron resonances and perpendicular to an external magnetic field is considered by the kinetic-equation method. Both relativistic effects (Doppler effect of the second order) and collisions are taken into account. The dispersion equations obtained for ordinary and plasma waves near the cyclotron frequency harmonics are analyzed at different parameter values. (auth)

29068 (N-73-14744) LAGRANGIAN DESCRIPTION OF WARM PLASMAS. Kim, H. (Stanford Univ., Calif. (USA). Inst. for Space Research). May 1970. 162p. (NASA-CR-129922; SU-IPR-470). NTIS

Efforts are described to extend the averaged Lagrangian method of describing small signal wave propagation and nonlinear wave interaction, developed by earlier workers for cold plasmas, to the more general conditions of warm collisionless plasmas, and to demonstrate particularly the effectiveness of the method in analyzing wave–wave interactions. The theory is developed for both the microscopic description and the hydrodynamic approximation to plasma behavior. First, a microscopic Lagrangian is formulated rigorously, and expanded in terms of perturbations about equilibrium. Two methods are then described for deriving a hydrodynamic Lagrangian. In the first of these, the Lagrangian is obtained by velocity integration of the exact microscopic Lagrangian. In the second, the expanded hydrodynamic Lagrangian is obtained directly from the expanded microscopic Lagrangian. As applications of the microscopic Lagrangian, the small-signal dispersion relations and the coupled-mode equations are derived for all possible waves in a warm infinite, weakly inhomogeneous magnetoplasma, and their interactions are examined. (auth)

29069 (UCRL-74974) WAVE CONVERSION AND RESONANCES IN LASER LIGHT SCATTERING. Peratt, A. L. (California Univ., Livermore. Lawrence Livermore Lab). 16 Aug 1973. Contract W-7405-eng-48. 6p. (CONF-730906-5). Dep. NTIS $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

The calculation of the differential cross section for the scattering of an electromagnetic wave in an underdense plasma is discussed. The method used is based on the derivation of a formal relation between the autocorrelations of current density and dielectric tensor. The formulation leads to expressions that are particularly simple when the plasma is in thermal equilibrium. An enhancement of the scattering spectra because of the coupling of transverse waves and excitation of longitudinal slow wave resonances is found to result when the Doppler shift exceeds collisional frequencies when the differential scattering vector is aligned primarily perpendicular to the magnetic field. (auth)

29070 NONLINEAR THEORY OF A QUASIMONOCHROMATIC PACKET OF ELECTROSTATIC WAVES IN AN INHOMOGENEOUS PLASMA. Istomin, Ya. N.; Karpman, V. I.; Shklyar, D. R. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 6, 2072-2083(Jun 1973). (In Russian).

A nonlinear theory is developed of the interaction of a quasimonochromatic packet of electrostatic waves with resonant particles in a weakly inhomogeneous plasma. Expressions are obtained for the distribution function in the resonance range of phase space and also for the nonlinear decrement (increment) of the wave. In particular, it is shown that the nonlinear growth rate at large distances from the front boundary is determined by the difference between the mean distribution functions of the trapped and untrapped resonance particles. The qualitative peculiarities of the nonlinear evolution of the packet in a weakly inhomogeneous plasma are studied. (auth)

29071 DAMPING AND SATURATION OF A SECOND-ORDER ELECTRON PLASMA WAVE ECHO. Moeller, C. P. Pasadena, CA; California Inst. of Tech. (1973). 94p. University Microfilms Order No. 73-18,377.

Thesis (Ph.D.).

A description is given of experimental work on the damping of a second order electron plasma wave echo due to velocity space diffusion in a low temperature magnetoplasma. Sufficient precision was obtained to verify the theoretically predicted cubic rather than quadratic or quartic dependence of the damping on exciter separation. Compared to the damping predicted for Coulomb collisions in a thermal plasma in an infinite magnetic field, the magnitude of the damping was approximately as predicted, while the velocity dependence of the damping was weaker than predicted. The discrepancy is consistent with the actual non-Maxwellian electron distribution of the plasma. In conjunction with the damping work, echo amplitude saturation was measured as a function of the velocity of the electrons contributing to the echo. Good agreement was obtained with the predicted J_1 Bessel function amplitude dependence, as well as a demonstration that saturation did not influence the damping results. (Diss. Abstr. Int., B)

29072 MODE CONVERSION AT THE LOWER HYBRID PLASMA RESONANCE. Moore, B. N. Austin, TX; Univ. of Texas (1972). 229p. University Microfilms Order No. 73-18,473.

Thesis (Ph.D.).

The process of mode conversion, or linear wave transformation, near the lower hybrid resonance layer of a warm, inhomogeneous plasma is investigated theoretically. It is assumed that the density gradient is small and that second order Larmor radius effects can be neglected, but the effects of both collisional and noncollisional damping are included. Integral transform methods are used to obtain approximate wave solutions for both perpendicular and oblique propagation directions with respect to the static magnetic field. All of the Stokes regions are identified and the complete set of connection equations is derived. It is shown that these imply that, as long as there is negligible damping and the plasma is semi-infinite, all incident long wavelength energy is completely converted into short wavelength energy for both oblique and perpendicular propagation. However, it is also demonstrated that the conversion efficiency is exponentially decreased by any damping process at the critical layer and any reduction in the magnitude of the density gradient. Other effects investigated are tunneling of energy between back-to-back conversion layers and the shifting of conversion frequency to higher values as either temperature or k_z is increased. Numerical integration methods are developed and used for checking the asymptotic solutions in all regions and for verifying the connection formulas. It is shown analytically that a mode conversion process takes place in an inhomogeneous lattice with first and second neighbor interactions. The solution for initial, or driven, pulse disturbances is derived and used to develop an expression for conversion efficiency in the lattice. This expression is compared with the plasma conversion efficiency equation. The energy conversion equation for a doubly refracting, uniform dielectric is derived, and it is demonstrated that terms, representing circulating energy, exist which can be of significance in wave transformation processes in nonuniform media. (Diss. Abstr. Int., B)

29073 ROLE OF STRONG ELECTRIC FIELDS IN THE GENERATION OF HARMONICS. Buti, B. (Physical Research Lab., Ahmedabad, India); Jayaram, S. J. Phys., A (London); 6: No. 9, 1429-1438(Sep 1973).

The nonlinear evaluation of the reflected and the transmitted fields of the fundamental and third harmonic waves, which are generated by the interaction of an intense microwave with a weakly ionized nitrogen plasma slab, is carried out by solving the nonlinear Maxwell equations numerically using a Runge–Kutta method. It is found that an increase in the fundamental field increases the harmonic output. For an incident field of about 3 esu and of frequency $\omega = 10^{10}$ rad s^{-1}, the peak power of the third harmonic obtained is about 0.04% of the fundamental which is in fairly good agreement with experiment. The harmonic output also increases with electron concentration in the range $\omega < \omega_p < 3\omega$ (where ω_p is the plasma frequency). The harmonic fields show resonant increase at fundamental and at harmonic frequencies. (auth)

29074 NONLINEAR INTERACTION OF HIGH AMPLITUDE LANGMUIR WAVES IN A COLLISIONLESS PLASMA. Ivanov, A. A.; Nikulin, M. G. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 168-174(Jul 1973). (In Russian).

The behavior in time and space of high-amplitude Langmuir waves in a collisionless plasma is considered for the case when the wave energy density greatly exceeds the plasma pressure. It is shown that, under the action of the high-frequency force, the electrons and ions escape from that part of space in which the wave amplitude is larger. This results in the formation of a wave of the simple Riemann wave type. Under certain conditions the wave may overturn and thus lead to ion heating. (auth)

29075 NONLINEAR DISSIPATION OF ELECTROMAGNETIC WAVES IN A PLASMA. Pustovalov, V. V.; Silin, V. P. (Lebedev

Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 1, 195-205(Jul 1973). (In Russian).

Absorption of an intense transverse electromagnetic wave in a plasma is studied within the framework of the theory of nonlinear wave interaction. The dissipation mechanism consists in nonlinear transformation of a transverse wave into an electron Langmuir oscillation (due to induced scattering by the plasma particles) which is absorbed by the electrons with a Landau decay decrement. The effective nonlinear dissipation frequency is found which is a transcendental function of the time-dependent intensity of the absorbed transverse wave. The results obtained are discussed in relation to the problem of interaction between intense light beams and matter. In a laser plasma with a temperature $\gtrsim 1$ keV the effective nonlinear dissipation frequency of light beams $\gtrsim 3 \times 10^{14}$ W/cm^2 exceeds the coulomb frequency of electron–ion collisions by at least an order of magnitude. (auth)

29076 PROPAGATION OF FREQUENCY-MODULATED PULSES IN A RANDOMLY STRATIFIED PLASMA. Besieris, I. M. (New York Univ., NY); Tappert, F. D. J. Math. Phys. (N.Y.); 14: No. 6, 704-707(Jun 1973).

Quantitative predictions are made of the effects of randomness and dispersion on the spreading, attenuation, and modulation coefficient of a frequency-modulated wave packet propagating in a randomly stratified isotropic plasma. In the absence of random fluctuations, the recently reported findings of Millman and Bell (IEEE Trans. Antennas Propag., 19: 152(1971)) are recovered. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 27428, 27941, and 29002.

29077 (AD-756290) ANTE 3: A FORTRAN COMPUTER CODE FOR THE SOLUTION OF THE ADJOINT NEUTRON TRANSPORT EQUATION BY THE MONTE CARLO TECHNIQUE. Final Report. Cohen, M. O.; Beer, M. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Oct 1972. 175p. (MR-7028; DNA-2988-F). NTIS.

ANTE 3 is a FORTRAN code designed to solve the time-dependent neutron transport equation in a three-dimensional geometry by the adjoint Monte Carlo technique. The code uses point energy cross section data derived from the ENDF 3 libraries. In addition to theoretical discussions, a complete description of computer input and output is presented. ANTE 3 is written in FORTRAN 4 and is presently operational on a CDC-6600 digital computer. (NTIS)

29078 (AD-760969) TRANSPORT THEORY OF PENETRATION BY HEAVY IONS. Manning, I.; Padgett, D. W. (Naval Research Lab., Washington, D. C.). Jun 1973. 44p. NTIS.

The feasibility of a physically realistic Boltzmann-type transport theory for ion penetration of an amorphous target is considered. The fundamental transport equation for the penetrating particles is derived. The statistical details of the recoil atoms are frequently of vital importance; the transport equations are extended to include recoils. The approach includes, in principle, all of the Landau-Vavilov theories. (NTIS)

29079 (AD-761839) GAMMA-RAY MOMENTS COMPUTER CODE, GAMMON-I. Eisenhauer, C. M.; Simmons, G. L.; Spencer, L. V. (National Bureau of Standards, Washington, D. C.). Apr 1973. 43p. (NBS-TN-766). NTIS.

A computer code for generating spatial-angular moments of gamma ray energy fluence in an infinite medium is described. The equation for moments of the energy fluence is given and the techniques used for the solution are discussed. The structure of the code and of the main sub-routines is also given. Details of the input and output data are presented and the printout from a sample problem is included. (auth)

29080 (AED-CONF-71-400, pp 205-216) MULTIPLE SCATTERING OF FAST ELECTRONS IN THICK TARGETS. Roos, H.; Harder, D. (Univ., Wuerzburg, Ger.). 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

A telescope with gas counter and semiconductor detector is used to measure the angular distribution behind thick targets. The telescope permits the separate detection of electrons and bremsstrahlung quanta. Experimental studies describe the transition of the electron angular distribution into the "complete diffusion" as well as into the region of the electron–bremsstrahlung shower and the validity of the Z/E_0 similarity rule for angular distributions in the incident energy range from 5 to 20 MeV. (tr-auth)

29081 (AED-CONF-71-400, pp 227-234) ELECTRON RANGE AND DEPTH DOSE CURVE IN THE ENERGY RANGE OF 30 TO 62 MeV. Schulz, H. J. (Univ., Wuerzburg, Ger.); Harder, D.; Kneissl, U. 1972. (In German).

From conference on report of electron accelerator working group; Giessen, Germany (23 Sep 1971).

By using a large-area ionization chamber which can be arranged in various depths of an absorber consisting of plates, electron depth dose curves in Plexiglas, Al, Cu, and Pb were measured at the Giessen linac. The relationship between electron energy and practical range was determined. It deviates from linearity at low atomic number above 30 MeV. For high atomic number, a modification of the practical range above 45 MeV is necessary. (2 figures) (tr-auth)

29082 (BNWL-1751(Pt.2), pp 100-102) ENERGY STRAGGLING PARAMETERS FROM PROTON SINGLE EVENT SPECTRA. Wilson, W. E.; Roesch, W. C.; Glass, W. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

Of fundamental interest to understanding the microdosimetry of protons is stochastic nature of the energy loss process in absorbers sufficiently thin that the interaction cross section remains constant. Under these conditions and assuming statistically independent collisions, the equation for the frequency distribution of energy losses (straggling distribution in the absorber) is given. The variance of the distribution divided by its mean can be shown to be independent of the mean number of collisions. This ratio is a quantity frequently appearing in the theory of microdosimetry and is numerically equal to the ratio of the second and first moments (m_2/m_1) of the interaction cross section for a loss. Values for m_2/m_1 for H_2, N_2, CH_4, and C_6H_6 are tabulated. (MHR)

29083 (CEA-R-4399) EVALUATION OF THE EQUIVALENT DOSE RATES DUE TO NEUTRONS EMITTED BY PLUTONIUM METAL, PLUTONIUM OXIDE, AND PLUTONIUM FLUORIDE: GRAPHS. Gouguet, J. (Commissariat a l'Energie Atomique, La Hague (France)). 1973. 89p. Dep. NTIS (U. S. Sales Only) $6.50. (In French).

In irradiated fuel processing plants, the personnel concerned with radioprotection often require a rapid estimation of the equivalent dose rates due to neutrons emitted by plutonium or plutonium compound sources (sources having different physical and geometrical characteristics). Graphs are presented which facilitate rapid determinations. Expressions enabling the specific emissions of Pu or Pu compound sources to be calculated are given, the contribution of the fission neutrons produced being taken into consideration. Thus Pu can arise from fuels having different physical characteristics. As an example of the application of the techniques outlined, graphs enabling the equivalent dose rates to be evaluated in contact with or at some distance from sources of Pu metal or Pu oxide or fluoride are presented, the Pu being obtained from natural U rods having been irradiated at different burn up in uranium-graphite-gas type reactors. (auth)

29084 (COO-3522-2) BIOLOGICAL AND CLINICAL DOSIMETRY. Annual Progress Report, July 1, 1972–June 30, 1973. Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York). 1973. Contract AT(11-1)-3522. 62p. Dep. NTIS $5.25.

Detailed studies were made of the collimated neutron fields produced in the $^{9}Be(d,n)^{10}B$ and the $^{9}Be(^{3}He,n)^{11}C$ reactions, using the 8 MeV deuteron and 25 MeV ^{3}He beams obtained from the MSKCC isochronous cyclotron. The properties which were studied include: the angular distribution of the total dose, the attenuation properties of various materials and the depth dose behavior of the total dose, the gamma ray dose, and the neutron fluence. Isodose distributions have been obtained and used to calculate preliminary treatment plans. Distributions of the dose in LET were obtained at a number of points within the fields and used in the interpretation of some radiobiological studies. A tissue equivalent calorimeter system was assembled. Preliminary results and the attending problems are discussed. Detailed dosimetry studies of ^{252}Cf were conducted. Neutron and gamma ray absorbed dose distributions were measured and preliminary estimates of the beta ray dose are discussed. Preliminary results of a series of rabbit testes irradiations are also given. Further evaluation tests were performed on the prototype orthogonal strip, ultra pure germanium camera. The camera detector area is 4 cm^2. Tests with a point source of ^{57}Co(122, keV) and ^{99m}Tc(140 keV) phantom demonstrated that the scintillation type cameras cannot match the 4mm spatial resolution of the germanium camera obtained with in-vivo tests on small mammalian organs. In initial stability tests, the germanium camera displayed no ill effects in several cyclings between room temperature and liquid nitrogen. Some deterioration occurred when the cryostat was opened to air. Ultra pure germanium diodes with boron implanted p^+ contacts were constructed from 5 cm diameter material using "in house" facilities. The diodes were evaluated for use in fabrication of an orthogonal strip matrix. A square (10×10) orthogonal strip matrix of (3.25×3.25) cm^2 area and nearly 9 mm thickness was constructed and is operational. A single such unit increases the area of the gamma camera detector to almost 11 cm^2 with around 3 mm spatial resolution. Measurements of ^{57}Co(122 keV) show an energy resolution (FWHM) of 4 keV. Tests on stability, electrical and image characteristics have begun. (auth)

29085 (IAE-2135) INFLUENCE OF THE MEDIUM ON THE ULTRARELATIVISTIC ELECTRON SLOWING DOWN SPECTRUM WITH TAKING INTO ACCOUNT ENERGY LOSSES DURING THE RADIATION PROCESS. Bazylev, V. A.; Varfolomeev, A. A.; Zhevago, N. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 28p. (In Russian). INIS.

The effect of the specific energy loss on the slowing-down radiation of ultrarelativistic electrons in a dense medium by the

induced dependence of the multiple scattering constants of the electrons on their energy was studied. It was shown that consideration of the change of the scattering constant in the radiation process leads to supplementary suppression of the slowing-down radiation in comparison with the usual effects of multiple scattering. Analytical expressions were obtained for the spectrum of the slowing-down radiation, taking into consideration the multiple scattering with variable constants and absorption of the virtual quanta in the case of relatively small energy losses of the electrons. (tr-auth)

29086 (KFKI-73-19) MONTE CARLO CALCULATIONS ON CHEST X RAY EXAMINATIONS. Results for Monoenergetic Beams. Koblinger, L. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Some important quantities, like the dose absorbed in internal organs, are in practice not measurable during diagnostic x-ray examinations. This paper aims to demonstrate how the introduction of Monte Carlo calculation techniques into diagnostical studies can help in their determination. After a short description of the principles of method and a computer code which was developed for the purpose some results of relevance to chest radiography are presented. The patient is represented by the inhomogeneous Snyder phantom, while the x-ray source is simulated by a parallel beam of photons. The spectra of both the image-forming and backscattered photons and the doses absorbed in the different organs are determined, for discrete initial energies from 25 up to 150 keV. Comments on the contrast of the x-ray image are also included. (auth)

29087 DETERMINATION OF THE OPTICAL CONSTANTS OF BISMUTH IN THE ENERGY RANGE FROM 2 TO 40 eV FROM ELECTRON ENERGY-LOSS MEASUREMENTS. Zacharias, P. (Univ., Hamburg). Opt. Commun.; 8: No. 2, 142-144(Jun 1973). (In German)

The energy loss function Im $(-1/\epsilon)$ of bismuth was determined by energy loss experiments with 60 keV electrons. By means of Kramers–Kronig analysis the complex dielectric constant $\epsilon = \epsilon_1 + i\epsilon_2$ has been calculated. The results are compared with data derived from optical and energy loss experiments of various authors. (auth)

29088 THEORETICAL AND EXPERIMENTAL VALUES FOR MASS ATTENUATION COEFFICIENTS OF γ RAYS BY COAL. Jardel, L. (Laboratorium Fizyki, Katowice, Poland). Nukleonika; 18: No. 4, 183-194(1973). (In Polish).

Values of mass attenuation coefficients for gamma-rays were determined experimentally for coal samples and the results were compared with values calculated from the chemical composition. Factors affecting the values thus found for mass attenuation coefficients were also given and attention drawn to the possibility of using the calculated coefficients when developing methods of determining the ash content of coal in the 30 to 60 keV energy range. (auth)

29089 INVESTIGATIONS ON AUTORADIOGRAPHY BY MEANS OF COLOUR FILMS. Bodemann, M.; von Erichsen, L. (Univ., Bonn). Messtechnik; 81: No. 4, 99-103(1973). (In German).

Additional energy information can be obtained by the use of three- or multilayer color films for autoradiographic purposes instead of black-and-white plates. β-emitters of different maximum β-energy produce different film colors, the color intensity—as usual—being proportional to the activity. α-radiographs from n,α-reactions (^{6}Li,^{10}B) by reactor irradiation can also be obtained because the interaction densities of α and γ within the color layers differ considerably. (GE)

29090 RANGES OF ^{235}U FISSION FRAGMENTS IN NATURAL ELEMENTS. Rustichelli, F. (Commission of the European Communities, Ispra, Italy). Z. Phys.; 262: No. 3, 211-220(1973).

From a recent work by Aiello, Maracci and Rustichelli, dealing with transmission of ^{235}U fission fragments in solid media, it appeared that the Lindhard, Scharff and Schiott theory is able to predict in a satisfactory way the relative stopping powers of different elements for the ^{235}U fission fragments. On the basis of the work and using available absolute experimental data for average ranges in few elements, a complete set of average ranges of ^{235}U fission fragments in all existing natural elements was derived. This set includes for each stopping element, ranges for the median light fission fragment, for the median heavy fission fragment and for the overall median fission fragment. (GE)

29091 DOSE DISTRIBUTION OF FAST ELECTRONS AND ULTRAHARD PHOTONS IN TRANSLATION MOVEMENT FOR LARGE-FIELD IRRADIATION ON THE BETATRON. Hattula, T.; Riehle, I.; Skladny, I. (Univ., Zurich). Strahlentherapie; 146: No. 1, 31-35(1973). (In German).

It is demonstrated that the technique of translation movement on the 45-MeV-Asklepitron offers a simple possibility to cover large irradiation fields everywhere with equal doses. The inhomogeneous region on the field border can be considerably diminished by the choice of adequate field-length or by satellite covering. Some examples are given for dose distributions in irradiation with 45-MV-photons and electrons of different energy. (GE)

29092 ELLIS FORMULA. Healy, J. B. Brit. J. Radiol.; 46: No. 548, 644(Aug 1973).

Some of the limitations of the Ellis formula concerning single dose equivalent are briefly pointed out from the point of view of the average radiotherapy practitioner. It is also suggested that it would be unrealistic to demand an accuracy of 5% from formulas relating to biological events which are difficult to measure. (UK)

29093 RADIATION PROTECTION MEASUREMENT. Kiefer, H.; Maushart, R. Oxford; Pergamon Press, Ltd. (1972). 562p. £10.

The development of radiation measurement techniques is essential for practical radiation protection, in forewarning of contamination, validation of protection measures and limitations of radiation burdens to the permissible values. This book describes the instruments and techniques for dose and activity measurements, identification of individual nuclides and protective measurements in nuclear accidents. Special reference is made to problems of accident dosimetry and incorporation measurements. Individual chapters are devoted to: dose determination (local and personal dose monitoring); activity determination (measurement in water, air, food and other biological substances, and internal contamination); radionuclide determination (determination of radiation type, half-life and energy, and radiochemical methods); determination of specific radionuclides; measurements for population protection; and development trends. (Occup. Saf. Health Abstr.)

29094 METHODS FOR CALCULATION OF DOSE DISTRIBUTIONS. Schoknecht, G. (Bundesgesundheitsamt, Berlin). Atomkernenergie; 21: No. 4, 240-247(1973). (In German).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e. V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

Dose distributions which are especially important in radiation therapy can be calculated in different ways. In the dose matrix method dose values determined for the grid points of a coordinate grid are used as basis for calculations. In the decrement line method linear dose distributions across the radiation field are measured. A completely theoretical calculation is performed by the Monte Carlo method. It was found to be most practical to restrict Monte Carlo calculations to a pencil beam. From pencil beam dose distribution the calculation of dose distribution of extended fields is possible. (GE)

29095 GRAPHS FOR DOSIMETRIC SUBSTANTIATION OF A SHORT-DISTANCE ROENTGENOTHERAPY. Akatkin, O. A. Med. Radiol.; 18: No. 7, 59-65(Jul 1973). (In Russian).

On the basis of dosimetric measurements and also mathematical calculations made on the computer "Minsk-22" an album of universal graphs for dosimetric substantiation of a short-distance roentgenotherapy was compiled. With the help of graphs it is possible to evaluate the quantitative content of radiation on the half-value attenuation layers in alumnium and to define the surface (skin) and depth doses of the irradiated biological objects with performance duty of a generation U-10–50 kV and primary filters from 0.1 up to 3 mm Al. The album is intended to be used in practical therapeutic institutions and roentgenotherapeutic rooms. (auth)

29096 REALIZATION OF THE VARIANT OF THE MONTE CARLO METHOD ON THE CENTRAL COMPUTER IN CALCULATIONS OF TISSUE DOSES OF NEUTRONS. Ivanov, V. N.; Parfenov, E. N. (All-Union Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 18: No. 7, 52-59(Jul 1973). (In Russian).

The algorithm of the realized variant of the "Monte-Carlo" method was described on the central computer with conditional absorption of particles in calculations of tissue doses of neutrons of collimated and extended beams under conditions characteristic of neutron-capture therapy. The peculiarities of the method substantial for its realization on a central computer and also factors influencing the errors of tests which consist of correlated events are under discussion. In particular, the dependence of relative error of doses of nucleus output on the number of collisions of neutrons contributing to the dose is studied.

A conclusion is made that the error of mean value for Poisson's distribution can serve only as a rough assessment of accuracy of calculations as it does not take into consideration the variations of the extent and transfer of energy in separate interactions. (auth)

29097 LOW ENERGY ELECTRON BACKSCATTERING AND TRANSMISSION THROUGH THIN SHEETS OF MATTER. Smirnov, V. V.; Shalotenko, K. N. At. Energ. (USSR); 33: No. 2, 700(Aug 1972). (In Russian).

This paper was summarized as paper No. 602/6707 with full copy held by TIC.

Backscattering of electrons from various materials and their transmission through thin sheets of matter were investigated. The spectra and spatial distributions for monoenergetic electrons in the 7.5 to 129.2 keV range, backscattering from various materials, and for electrons passing through sheets of a substance up to 120 $\mu g/cm^2$ in thickness were studied with the aid of an iron-free magnetic β-spectrometer. Preparations of the radioisotopes ^{57}Co and ^{109}Cd, applied by electrocapillary spraying on a thin (less than 18 $\mu g/cm^2$) metallized backing, served as sources of the monoenergetic electrons. The backscattering coefficients for 13.5 keV electrons, obtained through spectral measurements, comprised 1.17, 1.30, 1.46 for aluminum, stainless steel, and tungsten, respectively. The experimentally determined dependence of the backscattering coefficient (η) on the atomic number of the material (Z), for the range of electron energies being considered, when $Z > 8$ is determined by the empirical relation $\eta = 1 + (Z - 8/2Z)$. The values for the extrapolated ranges in bismuth and nitrocellulose, which appear to be equal for 13.5 keV electrons and thicknesses of 150 and 130 $\mu g/cm^2$, respectively, are determined by the graph for the attenuation of the electron flux upon transmission through identically thick sheets of matter. The ratios between the electrons transmitted, absorbed, and backscattered by the sheets are found through their energy and spatial distributions. For 50 and 120 $\mu g/cm^2$ thick sheets of bismuth, the fraction of 13.5 keV electrons transmitted, backscattered, and absorbed by the sheets comprised 63, 17, 20, and 34, 38, 28%, respectively. The relative standard error in the determination of the backscattering and absorption coefficients for low energy electrons did not 8%. (auth)

29098 PERTURBATION OF γ-RADIATION FIELD WHEN OBJECTS IN FILLER ARE EXAMINED. Zav'yalkin, F. M. At. Energ. (USSR); 33: No. 3, 772(Sep 1972). (In Russian).

This paper was summarized as paper No. 607/6632 with full copy held by TIC.

The dependence of the characteristics of the field of scattered radiation, when an object is lodged in the filler, on the parameters of both the object and the filler at different radiation energies was investigated. Results of Monte Carlo calculations of the differential flux $N(\omega,E,H)$ of the photons, and of the intensity $\Phi(\omega,E,H)$ of the scattered radiation from a plane unidirectional source emitting photons of energy $E_0 = 1.25$ MeV beyond an iron barrier of thickness up to $\mu H = 8$ and filler [melt of a tin–lead mixture (30%)], and also of aluminum and filler (91% Ch_2I_2 solution in C_6H_6), for a source such that $E_0 = 0.66$ MeV, were used in the analysis. A formula for the relative variation $\delta_\Phi(H)$ of the intensity or for the variation $\delta_N(H)$ of the radiation flux beyond the barrier when the object was removed from the filler was derived. Results of calculations of $\delta_\Phi(H)$ and $\delta_N(H)$ with the object completely replaced by filler are tabulated in the article. As the thickness is increased, the values of $\delta_\Phi(H)$ and $\delta_N(H)$ tend asymptotically to a saturation level, attaining 30 to 45% at $\mu H \approx 4$. The angular distribution is approximated. These values of the characteristic angles θ_0 for iron and aluminum are greater than for the corresponding fillers. It is shown that the relative difference between the distributions of the scattered radiation beyond the object material and the filler increases with decreasing energy E and with increasing angle θ. In the limit as $\theta \to 0$ and as $E \to E_0$, i.e., in the case of collimated radiation, the intensity ratio or the flux ratio of the scattered radiation becomes proportional to the density ratio of the electrons of the materials used. Note also that $\delta_\Phi(H) < \delta_N(H)$ at different values. (auth)

29099 SURFACE DOSES AND MATHEMATICAL EXPRESSIONS FOR DOSE CALCULATION IN BUILD-UP REGIONS FOR VARIOUS TELECOBALT UNITS AND LINEAR ACCELERATORS. Onai, Y.; Irifune, T.; Tomaru, T.; Uchida, I. (Japanese Foundation for Cancer Research, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 9, 735-743(Dec 1972). (In Japanese)

Dose distributions in the buildup regions under various conditions of irradiation for several telecobalt units and linear accelerators (4.3, 6, and 10 MV x rays) were measured with a shallow chamber. Its active volume was 1 cm in diameter by 2 mm deep. If a filter is used, surface peak dose ratios for any telecobalt units agree within ±10% under the same conditions of field size, filter-surface distance, and filter materials. Without a filter, however, difference was observed between the Theratron 60 telecobalt unit and other units because of the difference in design of the diaphragm. For filter- or diaphragm-surface distance greater than 10 cm, no significant difference was observed between no-filter and plastic filter except the Theratron 60, although there was a difference between filters of intermediate and low atomic number materials. For the plastic filter with the same field size and filter-surface distance, there was little difference in surface peak dose ratio between telecobalt and 4.3 MV x rays over the range of field size 5 × 5 to 25 × 25 cm^2, and also between telecobalt and 10 MV x rays for large field sizes. For small field sizes, however, surface peak dose ratios for 10 MV x rays were lower than those for other radiation qualities. Tissue peak dose ratios or tissue air ratios in the buildup regions (in the range of $0 \le d \le d_0$) may be expressed in the form of $TPR(d,A) = 1 - (1 - K'(0)A^{m'(o)})e^{-\lambda d}$ (1) or $TAR(d,A) = K(d_0)A^{m(d_0)}\{1 - (1 - K'(0)A^{m'(o)})e^{-\lambda d}$ (2) where A is the field size at the depth d, d_0 is the depth of the peak dose, and K, m, K', m', and λ are constants for a given radiation quality. When a plastic filter is used, $K'(0)A^{m'(o)}$ in equation (1) or (2) may be expressed as $TRP(0,A) = K'(0)A^{m'(o)} = \alpha(FSD)^{-\beta}A^{m'(o)}$ (3) The error of these expressions is less than 0.5 mm of the displacement in isodose curves and 10% of the dose. (auth)

29100 DOSE REGULARITIES UNDER ION BOMBARDMENT OF SOLIDS. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 18: No. 3-4, 283(1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching/Munich, Germany (Sep 1972).

It is stated that although the product of ion current density and time of irradiation is usually accepted as the definition of ion dose, this is valid only if the time interval required for the actual measurement is small compared with the relaxation time (approximately the bombarded ion penetration depth divided by the velocity of the irradiated surface motion due to target sputtering). In typical experiments the relaxation time is of the order of some minute to some seconds. When the time exceeds considerably the relaxation time the critical ion dose must be determined as the product of ion current density and relaxation time. (UK)

29101 RADIATION DOSES FROM MAN-MADE SOURCES. Muth, H. (Univ., Hamburg). Atomkernenergie; 21: No. 4, 230-239(1973). (In German).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e.V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

The concepts of "genetic dose to a population", "maximum permissible genetic dose" and "genetic dose limit", defined and used by the International Commission on Radiological Protection (ICRP) in their different recommendations during the last 20 years are summarized and discussed. A review of the present situation of exposure of the German population to radiation from man-made sources is given. The different possible sources of radiation exposure are discussed in detail (x-ray diagnosis and radiotherapy, medical use of unsealed radionuclides, occupationally exposed persons, nuclear weapons tests and so-called "small sources" like television sets, supersonic flights, enrichment of radioactivity in building material). The diagnostic use of x-rays delivers the main contribution to genetically significant annual population dose (about 50 mrem). In comparison to that the contribution from all other sources is relatively low (about 10 mrem). The consequences of this statement are discussed. (GE)

29102 DEPTH DOSES DISTRIBUTIONS, DOSE PROFILES, AND BACKSCATTERING FACTORS OF 300 KV X RAYS. Nuesslin, F.; Winter, R. (Medizinische Hochschule, Hanover). Strahlentherapie; 146: No. 1, 65-67(1973). (In German).

On the apparatus RT 305 for therapeutic hard x-rays the curves of the depth doses, dose profiles and factors of backscattering were measured for 8 different cones under a tube voltage of 300 kV. The measurements were made ionometrically in a water phantom. (GE)

29103 PASSAGE OF FISSION FRAGMENTS THROUGH SOLID MEDIA. Srivastava, B. K.; Mukherji, S. (Indian Inst. of Tech., Kanpur). pp 525-530 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

Radiation Protection Standards

29104 OBJECTIVE FUNDAMENTALS AND CONTENT OF THE NEW X-RAY REGULATION. Berger, H. (Deutsche Normenausschuss, Hamburg). Roentgenpraxis; 26: No. 7, 149-159 (1973). (In German).

The most important specifications of the new x-ray Regulation in the FRG which came into force on September 1, 1973, for the medical diagnosis by means of x-rays, are briefly discussed. (GE)

29105 SCIENTIFIC FOUNDATIONS OF LASER SAFETY REGULATIONS. Mahlein, H. F. (Siemens AG, Munich). Atomkernenergie; 21: No. 4, 262-268(1973). (In German).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e.V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

Starting with a brief introduction to lasers, the need for laser safety regulations is emphasized and the biophysical effects of laser radiation are reviewed. The parameters which are important for the effects of laser radiation on the eye are treated in detail. The values valid at the present time for the maximum permissible exposure of the eye and the skin are presented and some practical hints for the safe use of lasers are given. (GE)

29106 RADIATION PROTECTION STANDARDS. pp 38-86 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The manner in which the maximum permissible doses are established and administered is reviewed. The evolution of the maximum permissible dose is discussed as are the organizations involved in establishing and implementing radiation protection standards and the basic standards of maximum permissible radiation exposure. (ERB)

Radiation Source Calibration and Standardization

Refer also to abstract 27575.

Shielding Calculations and Experiments

Refer also to abstract 27954.

29107 (AD-760345) RADIATION DISTRIBUTIONS FOR SHIELDING CALCULATIONS. Final Report. Mooney, L. G. (Radiation Research Associates, Inc., Fort Worth, Tex.). Dec 1972. Contract DAHC20-72-C-0123. 57p. (RRA-T-7211). NTIS.

Sensitivity studies have indicated that representative neutron and secondary gamma-ray energy and angle distributions can be used for structure shielding analysis thereby eliminating the need for extensive transport calculations using many sources. A review of recent data and some new transport studies has shown that the radiation distributions are only weakly affected by differences in similar source spectra as well as the air/ground interface after transport through sufficient air. Representative neutron and gamma-ray distributions have been computed at a range of 1200 meters in infinite air from an intermediate yield thermonuclear weapon. Given are normalized, rotated distributions relative to the normals of the four walls and the roof of structures assuming a detonation 30 degrees above the horizon. Also given are averaged distributions which can be used as ring or halo sources if the direction of detonation is not known. (NTIS)

29108 (BMFT-FBK-73-17) RADIATION THROUGH COMPLEX GEOMETRICAL SHIELDING DUCTS. Koban, J. (Siemens A. G., Erlangen (West Germany)). Jul 1973. 118p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.

Shielding programs were developed which allow more exact calculations of dose rates through labyrinths, ducts, concrete overhangs, etc. The calculated γ-dose-rates in the air gap between pressure vessel and biological shield at KWO agreed well with measured values. The reflected γ-radiation was compared with calculations of GHH Sterkrade AG. Moreover, the γ-radiation of active pipes, filters, fuel elements in the fuel pool, active tanks and steam generators was evaluated. The results showed good agreement with measured values in nuclear power stations. (auth)

29109 METHOD OF CORRECTING FOR COLLIMATOR PENETRATION BY HIGH ENERGY GAMMA RAYS. Watts, R. S.; Pena, H. G. (Veterans Administration Hospital, Albuquerque, NM). J. Nucl. Biol. Med.; 16: No. 2, 51-54(1972).

A method of correcting for collimator penetration is described, whereby the elution or buildup of high energy gamma isotopes in selected body areas may be recorded. (auth)

29110 REMINDER OF THE PRINCIPAL ELEMENTS SERVING AS A BASIS FOR THE DESIGN OF SHIELDING AGAINST NEUTRONS. Penelle, G. (CEN, Mol, Belgium). J. Belge Radiol.; 56: No. 2, 167-174(1973). (In French).

Attention is drawn to the difficulty of calculating neutron shields, which results in particular from the complexity of the phenomena of the interactions of neutrons with matter. The possible interactions are classified either as slowing-down interactions or as absorbing interactions; this leads to the description of the phenomena of elastic diffusion and of inelastic diffusion. The interest of hydrogen as a slowing-down material, and the risk of emission of parasitic gamma rays during the interaction processes is derived from that description. Some practical data and a schematic example of the application of the theoretical considerations are included. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstract 28919.

29111 (COO-3235-21) STANDING WAVE SOLUTIONS TO THE SCHROEDINGER EQUATION. Kouri, D. J.; Levin, F. S. (Brown Univ., Providence, R. I. Dept. of Physics). 1972. 15p. Dep. NTIS $3.00.

The standing wave solution to the Schrödinger equation defined in terms of the standing wave Green's function for the full Hamiltonian is discussed. This solution is compared with the more usual standing wave solution. The former is shown to be one-half the sum of the usual ingoing and outgoing wave solutions obeying Lippmann–Schwinger equations. Partial wave elements of the two solutions as well as of the two reaction (K) matrices are found to be related by a simple normalization factor, viz, $\cos^2\delta_l$, where δ_l is the lth partial wave phase shift. Thus, either of the two standing wave solutions can be used to obtain the correct K matrix element, $\tan\delta_l$, since in each case it is the asymptotic ratio of the irregular to the regular solution. (auth)

29112 (IFA-FT-98-1972) EXPANSION OF THE UNBOUND SOLUTION OF THE SCHROEDINGER EQUATION IN TERMS OF HARMONIC OSCILLATOR WAVE FUNCTIONS MULTIPLIED BY A GAUSS ONE. Cirstoiu, B.; Deberth, C.; Hategan, C.; Sandulescu, A. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 16p. INIS.

Analytical expressions for the expansion coefficients of the unbound solution of the Schroedinger equation in terms of harmonic oscillator wave functions multiplied by a Gauss one are given. Numerical convergence of the expansion coefficients for the cases of plane and Coulomb waves is studied. (auth)

29113 (LYCEN-7302, pp C8.1-C8.23) INTRODUCTION TO HYPERSPHERICAL METHODS. Fabre de la Ripelle, M. (Paris Univ., Orsay, France). 1973. (In French).

From third study session on recent developments in theoretical nuclear physics; La Toussuire, France (5 Feb 1973).

The hyperspherical formalism is a method for solving the Schroedinger equation which treats the motion of a system whose position is determined by 3N linear coordinates in polar coordinates in a 3N dimensional space. A method is presented for constructing the basis of the potential and symmetrical hyperspherical harmonics given in a particle exchange. (FR)

29114 (NP-19850) TIME OPERATOR IN QUANTUM MECHANICS. I. Non Relativistic Case. Olkhovsky, V. S.; Recami, E.; Gerasimchuk, A. I. (Catania Univ. (Italy). Istituto di Fisica Teorica). May 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

Within a space-time description of nonrelativistic quantum objects, as space of physical states the space P of continuous L^2-functions is adopted: defined over the (total) energy interval $0 \leq E < \infty$; with square-integrable first derivatives; and for which a Hermitian energy-operator exists. Such a space P is dense into the Hilbert space of L^2-functions. It is then shown that a "good" time-operator exists, $\hat{t} = -(i/2)(\partial/\partial E)$, that acts onto P and: (i) is "symmetric" (but not self-adjoint) (ii) is canonically conjugated to the (total) energy; and (iii) satisfies Ehrenfest principle and Galilei invariance. The old, known objection by Pauli is recognized to point out merely that the operator $\hat{t}$ cannot be hypermaximal, as was clarified by von Neumann. But even nonhypermaximal operators may be given a physical meaning and may represent observables in quantum mechanics. As already emphasized previously confining only to self-adjoint operators in quantum mechanics is too restrictive a postulate. Notwithstanding that $\hat{t}$ has no eigenfunctions inside the Hilbert space, nevertheless one succeeds in calculating the average values of the time-operator over the physical states. The case of wave-packets moving freely is first considered. Secondly, the nonfree cases of scattering by a potential are investigated. (auth)

29115 DERIVATION OF A FEW SOLVABLE POTENTIALS FOR THE SCHROEDINGER EQUATION. Khan, I. A. (Government Engineering Coll., Rewa, India). Indian J. Pure Appl. Math.; 4: No. 1, 90-101(Jan 1973).

Making use of the second order of generalized associated Legendre and Stoke's differential equation, a few solvable potentials for the S-wave Schroedinger equation, were evaluated. Solutions for some of the potentials and their corresponding expressions for S-matrices were also established. Some known potentials fall as the particular cases of one of the potentials given. (auth)

29116 COMPUTATIONAL PROCEDURE FOR HIGH-ORDER ADIABATIC INVARIANTS. Bitoun, J. (CNET, Issy-les-Moulineaux, France); Nadeau, A.; Guyard, J.; Felix, M. R. J. Comput. Phys.; 12: No. 3, 315-333(Jul 1973).

When the frequency of the harmonic oscillator is slowly varying in time, the invariants can be expanded in powers of a small parameter characterizing the slowness of the variation. A recurrence procedure is presented yielding, with the help of an algebraic computer program, the terms of the adiabatic invariants determined up to the tenth order. The obtained formulas are checked over with two examples. (auth)

29117 INITIAL VALUE METHOD FOR THE EIGENVALUE PROBLEM FOR SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS. Scott, M. R. (Sandia Labs. Albuquerque, NM). J. Comput. Phys.; 12: No. 3, 334-347(Jul 1973).

An initial value method is presented for the calculation of characteristic lengths and characteristic functions of systems of ordinary differential equations. Very general nonseparated boundary conditions can be handled and the equations tend to be quite stable numerically. Numerical examples are presented which demonstrate the efficacy of the method. (auth)

29118 BOLTZMANN EQUATION: THEORY AND APPLICATIONS. Proceedings of the International Symposium Held at Vienna, Austria, September 4–8, 1972. Cohen, E. G. D.; Thirring, W. (eds.). Acta Physica Austriaca, Supplementum X. Vienna; Springer–Verlag (1973). 653p. (In English and German). (CONF-720947-). $54.80.

The conference included 25 papers. Separate abstracts were prepared for two papers. The remaining papers were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 28631 and 29119.

29119 KINETIC EQUATION FOR ELEMENTARY EXCITATIONS IN QUANTUM SYSTEMS. Khalatnikov, I. M. (Inst. for Theoretical Physics, Moscow). Acta Phys. Austr., Suppl.; 10: 563-573(1973).

From symposium on occasion of 100th anniversary of boltzmann equation; Vienna, Austria (4 Sep 1972). See CONF-720947-.

The application of the Boltzmann kinetic equation to the theory of quantum liquids is treated in detail. Applications to helium-3 are noted. (JFP)

29120 IMBEDDING METHODS IN APPLIED MATHEMATICS. Casti, J.; Kalaba, R. Applied Mathematics and Computation. Reading, MA; Addison-Wesley Publishing Company (1973). 317p. $8.50.

The topics covered are finite difference equations, initial value problems, two-point boundary value problems, Fredholm integral equations, variational problems, and applications in the physical sciences. (JFP)

29121 APPROACH TO THE REALISTIC EXPLANATION OF QUANTUM MECHANICS. Werbos, P. J. (Harvard Univ., Cambridge, MA). Lett. Nuovo Cim.; 8: No. 2, 105-109(8 Sep 1973).

A new approach to the explanation of quantum mechanics is described. The idea is expressed that the entire space–time continuum can approach an equilibrium. It is shown that the failure of physicists to construct a realistic explanation lies in a consistent naivete in their assumptions. (JFP)

29122 RELATIONS AMONG ELEMENTS OF THE DENSITY MATRIX. II. Exotic Conservation Laws. Park, J. L.; Band, W. (Washington State Univ., Pullman). J. Math. Phys. (N. Y.); 14: No. 6, 688-691(Jun 1973).

Ordinary quantal conservation laws are associated with null operators for time rate of change and are valid for causal evolution of the system through either pure or mixed states. There is, however, a larger class of quantal constants of the motion, some of which are conserved only for pure state evolution. After an analysis of the theoretical origins of these exotic conserved quantities, several illustrations are presented with empirical interpretations based on the quorum theory methods used previously. (auth)

29123 REGISTRATION OF A NONSTATIONARY POISSON PROCESS WITH FIXED DEAD-TIME SYSTEMS. Jovic, F. (Rudjer Boskovic Inst., Zagreb). Nucl. Instrum. Methods; 111: No. 3, 519-524(1973).

Registration of a nonstationary Poisson process with fixed dead-time systems is considered. It is shown that a recursive formula for the estimation of statistical values of the number of registered data can be approximated by an analytically usable relation for the probabilities of data registration. The expected number of regis-

tered data as well as the variance of the number of registered data are given. The real value of the registered density function is estimated. (auth)

29124 POINT TRANSFORMATION IN A MANY-PARTICLE SYSTEM. Vargas, R. A. (Univ. of Valle, Colombia). Rev. Mex. Fis.; 21: No. 4, 255-271(1972).

The many-particle point transforms previously developed in such a way that the transformation varies from the identity transformation—one isolated body—to the N-bodies interacting as the interparticle separations fall within an arbitrary chosen cutoff distance. The method is used to provide Hamiltonians for strongly interacting particles that are equivalent to the usual Hamiltonians. (auth)

Quantum Field Theories

Refer also to abstracts 28521 and 29162.

29125 (ITF-73-56-E) INVESTIGATION OF THIRRING'S TYPE MODEL SYSTEM AND CALCULATION OF CORRELATION FUNCTION. Bogoliubov, N. N. Jr.; Shumovskaya, A. G.; Shumovskii, A. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

The generalization of mini-max principle for the case of more general Thirring's type quasi-spin model with positive and negative interactions was constructed. (auth)

29126 (ITF-73-57E) PROBLEMS OF EXACTLY SOLVABLE MODEL SYSTEMS. Bogoliubov, N. N. Jr.; Shumovskaya, A. G.; Shumovskii, A. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The problem of constructing asymptotically exact expressions (in the limit of "large system") for the two-time correlation functions, Green's functions and s-time are examined. (auth)

29127 (NP-19848) SUPERLUMINAL INERTIAL FRAMES IN SPECIAL RELATIVITY. Mignani, R.; Recami, E. (Catania Univ. (Italy). Istituto di Fisica Teorica). Jun 1973. 8p. Dep. NTIS (U.S. Sales Only) $3.00.

The classical theory of tachyons concerning special relativity generalized to superluminal reference frames is outlined explicitly. (JFP)

29128 (PUC-TN-2/1972) COMPLEX MASSES AND ACAUSAL PROPAGATION IN FIELD THEORY. Marques, G. C.; Swieca, J. A. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Jan 1972. 40p. INIS.

It is shown that, in formulating a field theory with complex masses, keeping much closer to a detailed space–time description than existing treatments, one is naturally led to a modified Yang-Feldman equation. A consistent interpretation emerges, in which the complex masses are not associated with particles, but with a modification of the field propagation law, which becomes acausal. The indefinite metric of the usual treatments plays no role here. An investigation of both the case of interaction with an external potential, and of the fully quantized theory is carried out. No unitarity, or Lorentz invariance troubles arise, but in the case of a fully quantized theory, the contribution of virtual states with arbitrarily high energy, leads to an enhancement of the basic acausality of the propagation law, in a way that may lead to macroscopic deviations from causality. (auth)

29129 VERTEX FUNCTIONS AND POLARIZATION OPERATOR IN $(4-\epsilon)$-DIMENSIONAL FIELD THEORY. Ginzburg, S. L. (Inst. of Nuclear Physics, Leningrad). JETP Lett. (USSR) (Engl. Transl.); 17: No. 11, 448-450(5 Jun 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 11, 639-642(5 Jun 1973).

The vertex functions and the polarization operator in $(4-\epsilon)$-dimensional field theory with interaction ϕ^4 are calculated for small ϵ by direct summation of perturbation-theory diagrams. The derived expressions are valid both where perturbation theory is valid and in the scaling region. (auth)

29130 COMPOSITE MODELS OF CONFORMAL FIELD THEORY WITH A NONINTEGRAL NUMBER OF PARTONS. Migdal, A. A. (Inst. for Theoretical Physics, Moscow). Phys. Lett., 45B: No. 3, 272-274(23 Jul 1973).

Models are proposed, which have an explicit solution at any space-time dimension with nontrivial conformal interaction, but in general with ghost states. At two dimensions ghosts can be removed, and one obtains the Thirring model. The problem of ghosts at four dimensions remains open. (auth)

29131 HIGH ENERGY BEHAVIOR AND GAUGE SYMMETRY. Smith, C. H. L. (CERN, Geneva). Phys. Lett.; 46B: No. 2, 233-236(17 Sep 1973).

The imposition of unitarity bounds is shown to lead to a Yang-Mills structure in a wide class of theories involving vector mesons. Scalar fields are needed and, at least in simple cases, the unique unitary theory is of the Higgs type. (auth)

29132 TRANSFORMATION PROPERTIES OF PROPER VERTICES IN GAUGE THEORIES. Lee, B. W. (CERN, Geneva). Phys. Lett.; 46B: No. 2, 214-216(17 Sep 1973).

The Ward–Takahashi identities for (single-particle irreducible) proper vertices are derived for non-Abelian gauge theories; the renormalization of such theories, previously discussed in terms of the Ward–Takahashi identities for Green functions, can now be considerably simplified. (auth)

29133 NONRENORMALIZABLE INTERACTIONS AS LOW ENERGY LIMITS OF RENORMALIZABLE ONES. Rohrlich, F. (Syracuse Univ., New York). Lett. Nuovo Cim.; 8: No. 4, 208-212(22 Sep 1973).

The idea of shadow fields is used to formulate a renormalizable theory which involves the same particles as the unrenormalizable theory which it replaces and to which it reduces in the limit. The theory is based on a positive definite Hilbert space. The fields are termed vertical fields rather than shadow fields in order to emphasize that negative–norm states with which shadow fields are usually associated do not occur. The formalism is illustrated for the case of a Dirac particle interacting with a pseudoscalar particle. (LBS)

29134 CONFORMAL INVARIANCE IN QUANTUM FIELD THEORY. Grillo, A. F. (CNEN, Frascati, Italy). Riv. Nuovo Cim.; 3: No. 2, 146-164(1973).

Some of the most relevant results that follow from the assumed conformal invariance of field theory are illustrated. The topics discussed are: conformal invariance as an asymptotic symmetry in quantum field theory; some results from exact conformal invariance—Wightman functions and operator products; the bootstrap approach; and two-dimensional models. (LBS)

29135 PHOTON RETINUE AND INFRARED DIVERGENCE PROBLEM IN QUANTUM ELECTRODYNAMICS. Chiang, C. C.; Sudarshan, E. C. G. (Univ. of Texas, Austin). Nuovo Cim.; 17B: No. 1, 13-45(11 Sep 1973).

A careful study is made of the infrared divergence problem in quantum electrodynamics. It is found that the conventional treatments of this problem are not consistent with the concept of the photon as a real physical object and it is held here that the problem is a physical one rather than merely one of computational technique. By taking into account the cohesive photon retinue induced by the electron, it is shown that, for any definite number of soft-photon emissions, the cross sections are always divergence-free. The precise physical significance of the photon retinue in connection with experimental measurement is also discussed. (auth)

29136 CURRENT–CURRENT ENERGY-MOMENTUM TENSOR FOR CHIRAL DYNAMICS. Parish, C. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 8, 1217-1223(Aug 1973).

Starting from a canonical quantum field theory model and imposing invariance of the theory under a group, acting nonlinearly on the fields, a group-invariant energy-momentum tensor of the Sugawara form (Phys. Rev.; 170: 1659 (1968)) is constructed which is free of ambiguities due to factor ordering and has the required properties. (auth)

29137 SOME REMARKS ON CAUSALITY, LORENTZ INVARIANCE, AND THE GENERALIZED MATTHEWS' RULE FOR A MASSIVE SPIN ONE VECTOR FIELD IN AN EXTERNAL POTENTIAL. Jenkins, J. D. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 8, 1211-1216(Aug 1973).

A massive spin one vector field is quantized in the presence of an external potential, with source linear in the vector field, to provide an illustration of the aspects of a quantum theory in an external potential, which are reflections of the causal nature of the corresponding classical theory. In the examples considered, the S operator of the quantum theory is found to be Lorentz invariant or not, according as the corresponding classical theory is causal or not. The normal dependence of the interaction Hamiltonian, and the applicability of the generalized Matthews' rule are also discussed. (auth)

29138 INVARIANT VELOCITY DISTRIBUTION FUNCTION UNDER LORENTZ-COVARIANT TRANSFORMATION. Barashev, P. P. (Physico-Technical Inst., Moscow). Phys. Lett., 44A: No. 7, 537-538(13 Aug 1973).

An expression for a velocity distribution function which remains invariant under Lorentz transformations is obtained. (auth)

29139 JOST–SCHROER THEOREM AND WILSON'S FIXED POINT CONDITION FOR THE RENORMALIZED COUPLING CONSTANT. Gruem, H. R. (Univ., Vienna); Haberler, P. L. F. Phys. Lett.; 46B: No. 1, 114-116(3 Sep 1973).

On the basis of the Jost–Schroer–Pohlmeyer–Strocchi theorems it is proved that Wilson's renormalization group approach leads to the fixed point condition $\alpha_A^{fix} = 0$, unless the skeleton theory is a nonlocal theory with a non-analytic dependence on mass and coupling parameter. This result resolves a paradoxon in connection with the Adler–Schwinger–Bell–Jackiw anomaly. (auth)

29140 NULL PLANE QUANTUM ELECTRODYNAMICS. Rohrlich, F.; Ten Eyck, J. H. (Syracuse Univ., NY). Phys. Lett.; 46B: No. 1, 102-104(3 Sep 1973).

Covariant Feynman rules are given which permit calculations in NGED as easily as in the usual theory. The equivalence between the theories can be seen explicitly when all diagrams are summed. It holds already prior to renormalization. (auth)

29141 FORMULATION OF SPONTANEOUS BREAKDOWN IN THE PATH INTEGRAL METHOD. Matsumoto, H.; Papastamatiou, N. J.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Phys. Lett.; 46B: No. 1, 73-76(3 Sep 1973).

It is proposed as to how spontaneous breakdown of symmetry should be dealt with in the framework of the path-integral. The Goldstone theorem is derived from the path-integral method and the relation between symmetric Green functions and broken ones is discussed. (auth)

29142 GEOMETRICAL INTRODUCTION TO SPECIAL RELATIVITY. Cetto, A. M.; de la Pena A., L. (Univ. Nacional, Mexico City). Rev. Mex. Fis., Supl. Ensenanza; 21: E55-E66 (1972). (In Spanish).

It is shown that by means of purely geometrical considerations in terms of the Minkowski diagram, one can derive the fundamental laws of special relativity from the principles of equivalence of inertial observers and of constancy of the velocity of light. This method, which is known as k-calculus, has the advantage of exhibiting in a simple and illustrative way the direct relation that exists between the basic postulates of special relativity and various effects that are derivable from them, without resorting to the Lorentz transformation. (auth)

29143 HIGHER ORDERS IN THE INVARIANT PERTURBATION THEORY FOR CHIRAL LAGRANGIANS. Faddeev, L. D.; Slavnov, A. A. (Steklov Mathematical Inst., Moscow). Lett. Nuovo Cim.; 8: No. 2, 117-120(8 Sep 1973).

Nonlinear chiral Lagrangians of the Weinberg type originate from nonrenormalizable perturbation theory. It follows from previous results that due to chiral invariance all the counter terms may be written as local functions invariant with respect to the given transformations. A method of fixing the counter terms is given in which the equation of motion which follows from the Lagrangian is used. It is found that in the one-loop approximation only one new counter term is needed. (JFP)

29144 SUPERLUMINAL INERTIAL FRAMES IN SPECIAL RELATIVITY. Recami, E.; Mignani, R. (Univ., Catania, Italy). Lett. Nuovo Cim.; 8: No. 2, 110-112(8 Sep 1973).

The philosophy concerning the classical theory of tachyons (i.e., special relativity generalized to superluminal reference frames) is outlined explicitly. (JFP)

29145 QUANTUM FIELD THEORY OF SELF-INTERACTING SYSTEMS. Burt, P. B.; Reid, J. L. (Clemson Univ., SC). J. Phys., A (London); 6: No. 9, 1388-1396(Sep 1973).

Two self-interacting quantum field theories arising from the interaction lagrangian $\lambda\phi^4$ are discussed. Proceeding from exact particular solutions of the field equations which reduce to the positive and negative frequency solutions of the free field theory for $\lambda = 0$, the theories are quantized either by requiring (a) the commutator of the positive and negative frequency solutions to be independent of λ at $t = 0$ or (b) the propagator formed from the operator solutions of the field equations to be invariant with respect to translations. The solutions satisfying (a) are appropriate for scattering problems extending from $t = 0$ to $t = \infty$ while solutions satisfying (b) are valid from $t = -\infty$ to $t = \infty$. The solutions satisfying (a) become independent of λ for $t = 0$ but continue to depend on λ for large times while those satisfying (b) contain λ for all times. Both types of solutions satisfy the interacting field equations for all times. For times other than zero in case (a) and for all times in case (b) the equal-time commutator of the positive and negative frequency fields contains λ. The propagator for case (b) is calculated and is found to have poles at $(2n + 1)m$, where m is the mass of the associated free field and n is an integer. (auth)

29146 PATHOLOGY OF MASSIVE VECTOR FIELD THEORY. Yoshimura, T. (King's Coll., London). J. Phys., A (London); 6: No. 9, 1383-1387(Sep 1973).

It is shown that one cannot derive covariant equations for many-point functions of massive Yang-Mills fields by Schwinger's method of functional derivatives (Proc. Natn. Acad. Sci. USA; 37: 452-5, 455-7 (1951)) or its modifications. The noncovariant terms cannot be removed by modification of the definition of many-point functions. (auth)

29147 DINGLE'S QUESTION. Dingle, H. Nature (London); 244: No. 5418, 567-568(31 Aug 1973).

In this communication Dingle attempts to answer his many recent critics and to point out the simplicity of his clock paradox and the ageing paradox. (UK)

29148 SIMULTANEITY, TIME, AND SPACE IN THE RELATIVITY THEORY. Arifov, L. Ya. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk SSSR; 210: No. 6, 1320-1322(21 Jun 1973). (In Russian).

In a wide class of measurement systems the determination of Einsteinian simultaneity does not assure the possibility of a global description of physical processes in time and space. In order to resolve this difficulty, in any arbitrary system of measurement the four-dimensional space of relativity theory (special and general) is separated into time and physical space by relying mainly on the principle of causality. There is no basis to expect a constancy or even an isotropicness of the velocity of light in nonsynchronous systems of measurement. On the contrary, the optical experiment of Sagnac indicates a clear dependence of the local light velocity on the direction of propagation in a rotating system of measurement. Hence it is preferable to exclude any explicit or implied conceptions about the properties of the velocity of light in any formation of the concept of simultaneity which should be based on the principle of causality. Equations are presented for such a general system of measurement. (SJR)

29149 RADIATION TRANSFER IN QUANTUM ELECTRODYNAMICS. Golubev, Yu. M. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 2, 466-474(Aug 1973). (In Russian).

A space-time kinetic equation for electromagnetic fields is proposed which describes variation of the statistical field properties on passage through a resonant medium. As examples, spontaneous emission with allowance for re-emission and a single-mode laser with distributed parameters are considered. (auth)

29150 RELATIVISTIC TREATMENT OF MULTIPOLE RADIATION FROM AN EXTENDED CHARGE–CURRENT DISTRIBUTION. I. Asymptotic Properties of the Electromagnetic Field. Van Weert, C. G. (Univ., Amsterdam). Physics; 65: No. 3, 452-468 (1 May 1973).

The electromagnetic field due to a localized charge-current distribution is expanded in terms of a set of multipole moments defined with respect to a given time-like world line. The behavior of this expansion in the asymptotic region is studied, leading to the identification of the radiation field. It is shown that the radiation field is a null field. (auth)

29151 FACTORIZED WAVE EQUATIONS ON HOMOGENEOUS SPACES OF THE POINCARE GROUP. Cusson, R. Y. (Duke Univ., Durham, NC); Staunton, L. P. Nuovo Cim.; 17A: No. 2, 303-310 (21 Sep 1973).

Relativistic quantum-mechanical wave equations are presented for spinor functions defined on the parameter manifold of homogeneous spaces of the Poincaré group. These equations are linear in the momentum operators and may be iterated to define certain linear combinations of the Casimir invariants of the Poincaré group. The additional variables, over and above those of the Minkowski manifold, are expected to be related to some internal structure which is effectively hidden in the free theory, but which may become observable when interactions are introduced. The minimal coupling to electromagnetism and to other external fields is presented. (auth)

Gravitation and General Relativity

Refer also to abstracts 28360, 28385, and 29148.

29152 (IC-73/70) PARTICLE PHYSICIST'S APPROACH TO THE THEORY OF GRAVITATION. Duff, M. J. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1973. 53p. Dep. NTIS (U.S. Sales Only) $4.75.

The lectures cover gravity without geometry, quantum theory and the Schwarzschild solution, linearity versus nonlinearity for the significance of perihelion shift calculations, and quantizing the gravitational field. (JFP)

29153 REPRESENTATION OF MATTER IN THE GENERAL THEORY OF RELATIVITY. Wynne, V. A. (Memorial Univ. of

Newfoundland, St. John's); Derrick, G. H. Nuovo Cim.; 17B: No. 1, 122-128(11 Sep 1973).

The standard approach to the representation of matter in the general theory of relativity is often justified by appeal to the general-relativistic interpretation of Mach's principle. The position of the latter is briefly reviewed and seen to be precarious. It is suggested that what is required in general relativity is a sourceless set of field equations for the components of the metric tensor, with Einstein's equations now regarded as a definition of the matter tensor. (auth)

29154 SCALAR-TENSOR THEORIES AND CONFORMAL INVARIANCE. II. O'Hanlon, J. (Univ. of Dublin); Tupper, B. O. J. Nuovo Cim.; 17B: No. 1, 1-6(11 Sep 1973).

The requirement of conformal invariance imposed on scalar-tensor theories in previous work is applied to the most general action principle for such theories. It is shown that this requirement reduces the action principle to that previously obtained. Another conformally invariant action principle is also obtained. (auth)

29155 GRAVITATIONAL AHARONOV-BOHM EFFECT. Lawrence, J. K.; Leiter, D.; Szamosi, G. (Univ. of Windsor, Ont.). Nuovo Cim.; 17B: No. 1, 113-121(11 Sep 1973).

The massless Dirac equation is considered in the presence of weak external gravitational fields. In the presence of fields arising from moving mass currents, solutions are found which are analogous to those giving rise to the Aharonov-Bohm effect in electromagnetic theory. The mass currents play the role of the magnetic fields. Comparison is made with earlier analogous solutions by Plebanski and by Balazs and Bertotti, and an alternative physical interpretation is offered in which simply connected currents can produce an effect which is observable in principle. (auth)

29156 RELATIVITY AND QUANTIZATION. IV. A Unified Field Model of a Charged Particle (Model OK_2+). Anastassov, A. H. (Univ. of Sofia). Nuovo Cim.; 17B: No. 1, 99-104(11 Sep 1973).

A new nonsingular unified field model of a charged particle is proposed with effective gravitational mass M_0, global energy M_0c^2 and effective charge $e^2 = 2bM_0c^2$, where b is a characteristic constant. (auth)

29157 RELATIVITY AND QUANTIZATION. III. A Generator of Field Models of Particles. On the Centrosymmetric Metrics. Anastassov, A. H.; Vesselinov, S. G. (Univ. of Sofia). Nuovo Cim.; 17B: No. 1, 94-98(11 Sep 1973).

A compact and symmetric representation of the components of Einstein's tensor is proposed for the case of spherical symmetry. A simple term imposed on the metric leads to a global energy M_0c^2. A simple definition equation is found for the metric OK_1. (auth)

29158 RELATIVITY AND QUANTIZATION. II. Gravitational Field Model of Noncharged Particle (Model OK_1). Anastassov, A. H. (Univ., Sofia). Nuovo Cim.; 17B: No. 1, 89-93(11 Sep 1973).

A new centrosymmetric metric is proposed (metric OK_1), in which Einstein's tensor must be definitely interpreted as the real tensor of gravitational matter. The global energy corresponding to the metric OK_1 equals M_0c^2, where M_0 is the effective gravitational mass of the center. In that case the problem of divergence is solved. The new metric has singularities only in the center, but not on the Schwarzschild sphere. The Schwarzschild's radius gets a new intrinsic meaning. (auth)

29159 SPHERICAL-SYMMETRICAL METRICS IN THE THEORY OF RELATIVITY. Veselinov, S. G. (Univ., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 599-601(1973). (In French).

The condition for spherical symmetry combined with a given condition allow one to write the components of the Einstein tensor in a compact and very convenient form. From this a unique solution of the Einstein equations is found. It is proven that the obtained solution is the Reisner-Nordstroem solution. (JFP)

29160 GAUGE INVARIANCE OF THE DIRAC EQUATION. Smrz, P. J. Aust. Math. Soc.; 15: 117-122(Feb 1973).

An analysis is made of the Dirac Lagrangian by representing the Dirac matrices in Lie algebra as a U(2,2) group. A particular solution to the resultant equations is obtained to give the spherically symmetric solution of the Einstein equations with a cosmological term corresponding to the radius of the universe equal to $1\sqrt{m^2-a^2}$. (MRM)

29161 EMISSION OF GRAVITATIONAL WAVES BY AN ELECTROMAGNETIC CAVITY. Grishchuk, L. P.; Sazhin, M. V. (State Astronomical Inst., Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 2, 441-454(Aug 1973). (In Russian).

The possibility of gravitational wave emission under terrestrial conditions is considered. A qualitative formula is derived which yields the upper limit for the gravitation radiation flux from an arbitrary source with a small gravitational potential. The formula takes into account coherence of the source and "focussing" of its gravitational radiation. As a concrete emitter an electromagnetic cavity is considered. It is shown that the emitter whose parameters seem to be quite reasonable from a technical viewpoint, can create a gravitation energy flux of the order of 10^{-7} erg/cm^2·sec over an area of 1 cm^2 at a distance of 10^3 cm from the emitter. The possible parameters of the emitter are as follows: a superconducting resonant system with a total volume of about 10^9 cm^3 in which a standing wave 4 cm long exists, the mean energy density of the electromagnetic field being 10^{10} erg/cm^3. (auth)

29162 EIGENVECTORS OF THE ENERGY-MOMENTUM TENSOR IN THE EINSTEIN-MAXWELL THEORY. Woolley, M. L. Proc. Cambridge Phil. Soc.; 74: 281-288(Sep 1973).

It is shown that in the four-dimensional, source-free Einstein-Maxwell theory, four distinct orthogonal eigenvectors of the energy-momentum tensor may be obtained formally by the action of four projection operators on an almost arbitrary vector. The extremal field, of the unified theory of Maxwell, Einstein and Rainich, is obtained explicitly in terms of eigenvectors of the energy-momentum tensor and the energy-momentum tensor itself, expressed in terms of eigenvectors, is seen to take on two equivalent forms. From this, a two-parameter group of Lorentz rotations, which leave the tetrad of eigenvectors unchanged, is deduced. (auth)

29163 ROTATION OF GRAVITATIONAL-WAVE POLARIZATION BY WEAK GRAVITATIONAL FIELDS. Lawrence, J. K. (Univ. of Windsor, Ont.). Lett. Nuovo Cim.; 8: No. 2, 97-98 (8 Sep 1973).

It was previously found that when an electromagnetic wave propagates through a region of weak gravitational fields, its polarization vector may be rotated about the direction of propagation. A simple extension of this result is made to the polarization of tensor gravitational waves. (JFP)

29164 MAXIMAL FOLIATIONS OF EXTENDED SCHWARZSCHILD SPACE. Reinhart, B. L. (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.); 14: No. 6, 719(Jun 1973).

Smooth families of spherically symmetric maximal surfaces which are spacelike except at r = 2m are explicitly constructed in Schwarzschild space. Such surfaces should be useful in the study of initial value problems. (auth)

29165 COMPLEX COORDINATE TRANSFORMATIONS AND THE SCHWARZSCHILD-KERR METRICS. Newman, E. T. (Univ. of Pittsburgh). J. Math. Phys. (N. Y.); 14: No. 6, 774-776(Jun 1973).

Utilizing the fact that the Schwarzschild and Kerr geometries have an intrinsically defined Minkowski space associated with them, it is shown that these Minkowski spaces (as the Kerr parameter varies) can be viewed as "real slices" in a complexified Minkowski space. The complex Weyl tensor of each member of the family can then be viewed as a single complex field on the complex Minkowski space. Further, the degenerate principle null vectors associated with each geometry can be considered as projections into the "real slices" of a complex null vector field in the complex Minkowski space. These results may be considered as clarifying earlier work on obtaining the Kerr metric from the Schwarzschild metric by a complex coordinate transformation. (auth)

REACTOR TECHNOLOGY AND REGULATION

Refer also to abstract 29019.

29166 (TID-3324-R1-S1) TITLE LISTING OF CIVILIAN POWER REACTOR DOCKET LITERATURE IN NUCLEAR SCIENCE ABSTRACTS. Volume 27 (Jan.–June 1973). (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1973. 130p. Dep. NTIS $5.45.

A title listing of the safety analysis report literature Dockets for reactors and fuel processing plants, which have appeared in Nuclear Science Abstracts (NSA) in Volume 27 (January through June 1973), is presented. The arrangement of the text is by Docket number. Two tables of contents are provided, one listing is arranged by Docket number and the other is an alphabetic arrangement of reactor names. The NSA subject indexing for the entries is included. (FS)

29167 QUALITY ASSURANCE TERMS AND DEFINITIONS. New York; American Society of Mechanical Engineers (1973). 10p. (ANSI-N-45.2.10-1973).

Standards for certain terms and their definitions that are important to the uniform understanding of the intent of required quality assurance practices for the construction of nuclear power plants are presented. (JWR)

29168 QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1973). 43p. (ANSI-N45.2.11).

This standard provides requirements and guidance for a quality assurance program for the design of nuclear power plant structures, systems and components whose satisfactory performance is required: (1) to prevent accidents that could cause undue risk to the health and safety of the public; or (2) to mitigate the consequences of such accidents if they were to occur. (JWR)

29169 QUALITY ASSURANCE FOR PROTECTIVE COATINGS APPLIED TO NUCLEAR FACILITIES. Revision 9. New York; American National Standards Institute (1972). 36p. (ANSI-N101.4).

A standard providing a common basis for the quality assurance of protective coatings applied to nuclear facilities is presented. Quality assurance, as covered by this standard, comprises all those planned and systematic actions necessary to provide specified documentation and adequate confidence that shop or field coating work for nuclear facilities will perform in accordance with the specified requirements. (JWR)

29170 QUALIFICATIONS OF INSPECTION, EXAMINATION, AND TESTING PERSONNEL FOR THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1973). 5p. (ANSI-N45.2.6). American National Standards Institute, New York.

A standard is presented on the qualifications of personnel who perform inspection, examination, and testing activities that assure the quality of important parts of a nuclear power plant during the construction phase. These parts include those structures, systems, and components whose satisfactory performance is required: for the plant to operate reliably; to prevent accidents that could cause undue risk to the health and safety of the public; or to mitigate the consequences of such accidents if they were to occur. The requirements of this standard apply to personnel who perform inspections, tests, or nondestructive examinations; or who participate in the approval of procedures, the handling of data or test results, or the control of reports and records. (JWR)

29171 HOUSEKEEPING DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1973). 11p. (ANSI-N-45.2.3-1973).

Housekeeping requirements are presented for the control of work activities, conditions, and environments that can affect the quality of important parts of a nuclear power plant during the construction phase. These parts include the structures, systems, and components whose satisfactory performance is required for the plant to operate reliably, to prevent accidents that cause undue risk to the health and safety of the public, or to mitigate the consequences of such accidents if they were to occur. Housekeeping encompasses all activities related to control of cleanness of facilities, cleanness of material and equipment, fire prevention and fire protection including disposal of combustible materials and debris, control of access, and protection of equipment not denoted in other standards. (JWR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 29269, 29278, 29280, 29281, 29286–29290, 29294–29300, 29305–29309, 29314–29317, 29326, 29338–29342, 29349, 29350, and 29352.

29172 (AEG-E-3-2195) AFTER-HEAT DETERMINATION OF IRRADIATED URANIUM FUELS. (Allgemeine Elektricitaets Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). Feb 1972. 48p. (In German). INIS.

The after-heat produced in a BWR after scram was determined from the single energy amounts of fission and radioactive decay energies. Storage is not included in this calculation. Within the first seconds after shutdown, the amount of fission energy in the after-heat is predominant. During this time, there are fissions resulting from the decreasing neutron flux (individual shutdown behavior of a reactor) and from delayed neutrons. For times over 30 sec after shutdown, the after-heat is practically produced only by radioactive decay energies. The latter one is composed of the single β- and γ-decay energies and the corresponding decay rates of the fission products. The calculated after-heat is in good agreement with the values of other authors. (GE)

29173 (HASL-277) COMPARISON OF MEASURED AND CALCULATED RADIATION EXPOSURE FROM A BOILING WATER REACTOR PLUME. Gogolak, C. V. (Health and Safety Lab. (AEC), New York). Sep 1973. 24p. Dep. NTIS $4.00.

Calculations were made with several Gaussian plume exposure models for the vicinity of a boiling water power reactor. Absolute comparisons of these calculations with measurements made by continuously monitoring ionization chambers and thermoluminescence dosimeters for a period of two months indicate agreement within a factor of two. Parametric studies of buildup factor and plume rise were made, and the behavior of the models for short time periods was explored. (auth)

29174 (TID-26458) TECHNICAL REPORT ON DENSIFICATION OF EXXON NUCLEAR BWR FUELS. (Atomic Energy Commission, Washington, D. C.). 4 Sep 1973. 34p. Dep. NTIS $3.75.

Fuel densification (gaps in fuel pellet column), its mechanism, and its effects are discussed. Models used by Exxon to predict the consequences of fuel densification are given, and the analysis required for determining the effects on reactor operation and safety is described. Findings and conclusions of the Regulatory Staff review and evaluation of the Exxon BWR fuel (Oyster Creek) are given. (DLC)

29175 TRITIUM EXPERIENCE IN BOILING WATER REACTORS. Smith, J. M.; Gilbert, R. S. (General Electric Co., San Jose, CA). pp 57-68 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809–.

Tritium associated with the operation of boiling water reactors supplied by the Nuclear Energy Division of the General Electric Company is analyzed. The principal sources of tritium in a BWR are described. Monitoring and management of tritium are discussed. 15 references. (auth)

29176 TRITIUM GENERATION AND RELEASE TO IN-PLANT AND OFF-SITE ENVIRONS OF THE LA CROSSE BOILING WATER REACTOR. Steele, T. A. (Dairyland Power Cooperative, La Crosse, WI). pp 585-591 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809–.

Tritium sources in the LACBWR Reactor are discussed. The distribution, radiation doses, and release of tritium from the reactor are analyzed. 6 references. (DCC)

29177 PERFORMANCE OF LARGE NUCLEAR TURBINES. Spencer, R. C.; Miller, E. H. Combustion; 45: No. 2, 24-30(Aug 1973).

Nuclear turbine experience to date is summarized. Major problems and their solutions, performance records in terms of reliability and efficiency are outlined. The introduction of nuclear power in the late 1950's brought with it not only the unique characteristics and problems associated with steam from light water reactors—those of large volume flows of wet steam

with their potential for erosion, corrosion, and performance loss—but also those associated with the search for economy with larger capacity units. At this point in time, with more than 10,000 MW of nuclear capacity operating, these turbines have met their heat rate goals ... and their reliability record is better than that of equivalent maturity fossil turbines. At the present time 17,800 MW of nuclear units are waiting to be put in service. Of these, 8,500 MW in nine units are for application with boiling water reactors and 9,300 MW in eleven units are for use with pressurized water reactors. About two-thirds of these shipped units utilize the one- or two-stage steam reheat cycle with its lower potential for erosion-corrosion in the low pressure elements. Looking toward the future, it is evident that obtaining needed operating experience feedback or larger units will be dependent upon the rate at which industry problems are solved and the units placed in service. (auth)

29178 FEED AND CONDENSATE PUMPS IN NUCLEAR POWER STATIONS. Sturzinger, C. (Sulzer Bros., Ltd., Winterthur, Switzerland). Combustion; 45: No. 2, 6-14(Aug 1973).

Condensate and feed pumps operate in a direct circuit with the reactor in completely demineralized water. The design, testing, and servicing of booster, condensate, pull-out, re-entry, and feed pumps are discussed. (FS)

29179 PRESSURE RESISTANT OPENING VESSEL INTENDED FOR BOILING WATER NUCLEAR REACTORS. Costes, D. (to Commissariat a l'Energia Atomique). French Patent 2,134,824. 21 Apr 1971. 10p. (In French).

Prestressed concrete vessels intended for boiling water reactors are provided at their upper end with a large cross section opening which can be sealed with a demountable lid. This lid makes a sealed joint with the body of the vessel and is provided at its bottom part with an elongated insulating plug which extends beneath the level of the sealed joint. In order to avoid the formation of convection currents where the insulating coating of the vessel and the lid meet, the following device is proposed: a plug having a continuous peripheral skirting jutting out at the bottom, the main part of the vessel being provided with a channeling positioned such that the skirting descends into it when the lid is in place. (FR)

29180 SAFETY VALVE FOR A NUCLEAR REACTOR. Costes, D. (to Commissariat a l'Energie Atomique). French Patent 2,134,825. 21 Apr 1971. 9p. (In French).

A safety valve was developed for interrupting a fluid current which is actuated either by a command mechanism or by a clap-valve in the case of a violent drop in pressure downstream from the valve. It consists of a tubular valve body provided with a collar, a needle which moves along the axis of the valve body, and a means of axially displacing the needle in the collar, the part of the needle moving in the collar having fins which press against the collar and which are joined to a truncated head positioned above the needle (in the normal sense of the circulation of the fluid). These fins have a diameter greater than that of the collar and a small opening angle. This valve is intended particularly for the channels conducting vapor out of the prestressed concrete vessel of a nuclear reactor (e.g., a boiling water reactor) in which it automatically cuts the vapor feed of the channels in the case of the rupture of the latter. (FR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 27165, 29177, 29178, 29229, 29230, 29234, 29242, 29275–29277, 29279, 29282–29285, 29291–29293, 29301–29304, 29310–29313, 29318–29325, 29327–29337, 29343–29348, 29351, 29353–29372, 29374–29377, and 29399.

29181 TRITIUM IN PRESSURIZED WATER REACTORS. Locante, J.; Malinowski, D. D. (Westinghouse Electric Corp., Pittsburgh). pp 45-57 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809–.

The Westinghouse PWR Systems Division investigations are reviewed for the prediction, measurement, and long-term management of tritium produced in PWRs employing zircaloy clad fuel, silver–indium–cadmium control rods, boric acid as a soluble chemical shim, and borosilicate glass in burnable poison control rods. 4 references. (auth)

29182 ENVIRONMENTAL TRITIUM STUDIES AT A PWR POWER PLANT. Cohen, L. K.; Kneip, T. J. (New York University Medical Center, NY). Contract AT(30-1)-4178. pp 623-639 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809–.

The relative concentrations of tritium in several compartments of an estuarine environment are analyzed. Measurements were made of tritium in the loose and organically bound water in bottom sediments, rooted aquatic plants, fish, and ambient water. The area selected for this study was a thirty mile section of the Hudson River estuary which includes the Indian Point-1 Reactor. 19 references. (auth)

29183 EXPERIENCE ACQUIRED DURING THE SERVICING OF THE REACTOR AND THE PRINCIPAL COMPONENTS OF THE PRIMARY CIRCUIT OF THE ARDENNES NUCLEAR POWER PLANT. Bertron, L.; Cuisenier, R. (Societe d'Energie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet, France). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 99, 5-13(Jan 1973). (In French).

The results of the controls effected during the servicing of the reactor and the principal components of the primary circuit of the Ardennes nuclear power plant are given. The experience acquired during this work is presented. The radioprotection problems which arose are discussed. (FR)

29184 INTERNATIONAL NUCLEAR STATIONS ARDENNES AND JOSE CABRERA. Elec. Light Power, E/G Ed.; 51: No. 17, 52-54(Sep 1973).

Brief descriptions are given of the design, construction, and operation of the French Ardennes and the Spanish Jose Cabrera (Zorita-1) nuclear power (PWR) plants. (DLC)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 27733 and 29268.

29185 (AAEC/E-234) GEOMETRICAL PROPERTIES OF PACKINGS OF EQUAL SPHERES IN CYLINDRICAL VESSELS. Part V. Adaptation of Model to Packings in Cylindrical Vessels. Tingate, G. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1973. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

Following an exploratory study, detailed experimental determinations have been made of the properties of a range of unbiased random packings with cylinder-to-sphere diameter ratios of 11.4 and 8.71. Properties at the dense end of the range depend on the diameter ratio. Properties at the loose end of the range are independent of the diameter ratio, and agree closely with those computed from the model developed for the semi-infinite case. The model is adapted to the cylindrical case by means of quadratic equations whose coefficients depend on the cylinder-to-sphere diameter ratio. Although the adapted model is based on experiments with comparatively small diameter ratios, it is shown to hold for larger ratios, without the need to call further on experimentally determined properties. It is shown that commonly used preparation methods, such as placing or pouring spheres on the top surface, can result in packings with radial bias. Two methods of preparing unbiased random packings are described. (auth)

29186 (EUR-5020) PLUTONIUM AS A MAKE-UP IN THE THORIUM INTEGRAL BLOCK HTR FUEL ELEMENT. Graziani, G.; Rinaldini, C.; Bairiot, H.; Trauwaert, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75. EUR B. Fr. 50.–.

An analysis was performed in order to investigate the perspectives of using plutonium as a make-up instead of ^{235}U for a thorium cycle in a High Temperature Gas Cooled Reactor. A number of physics and economic parameters were varied. In particular: type of fuel particles (three degree of dilution of Pu into the graphite within the fuel kernels); heavy metal density in the fuel pin; Pu enrichment of the fresh fuel or, alternatively, the fuel discharge burn-up (between 40 and 100 GWD/t). Two types of fuel-cycle scheme, namely once-through and recycle of the bred fuel were considered. The following economic hypotheses were also parametrically varied; the ^{233}U credit, the Pu price and the fabrication cost. The calculations showed that it is possible to design integral block fuel cycles in which plutonium is the feed fuel. If not exceeding the reference age-factor of the uranium-thorium cycle is assumed as feasibility criterion, only once-through cycles will economically be acceptable (with a ^{233}U credit of 14 $/gm). By parametrically changing the value of

the fissile plutonium and imposing the fuel cycle costs to be equal to the cost of the reference uranium-thorium cycle, an equivalent plutonium value was deduced. The fissile value was found to be in the range between 8.4 and 9.5 $/gm, depending on the values adopted for the fabrication cost corresponding to the different degrees of plutonium dilution in the kernels. These values are almost independent of the burn-up and of the ^{233}U credit value. (auth)

29187 (GULF-GA-A-12492) CESIUM DIFFUSION COEFFICIENTS AND OTHER RESULTS FROM THE ANALYSIS OF PEACH BOTTOM D13-05 FUEL ELEMENT ACTIVITY PROFILES. Haire, M. J.; Zumwalt, L. R. (Gulf General Atomic Co., San Diego, Calif.). 26 Jul 1973. Contract AT(04-3)-167. 71p. Dep. NTIS $5.75.

Fission product activity profiles of ^{89}Sr, ^{90}Sr, ^{134}Cs, and ^{137}Cs from radial sections taken from the spine and sleeve of Peach Bottom fuel element D13-05 have been analyzed. The ^{89}Sr and ^{90}Sr activity profiles appear to have resulted from the decay of their gaseous precursors, ^{89}Kr and ^{90}Kr. Thus, no strontium metal diffusion data were obtained. It was determined that gaseous precursor concentration profiles in the sleeve may be similar in shape to that of the daughter metal owing to strong counter-flowing convective currents. Because of the uncertainty of the xenon precursor contribution to the total activity profile, cesium metal diffusion coefficients were not clearly established for the sleeve graphite. For the spine region of the fuel element, each profile component (gaseous precursor and directly released metal) was fitted quite closely by curves calculated using the FIPER code. This correlation instills confidence in the FIPER code and lends support to the concept that both metal and gaseous precursor follow a transport behavior which closely approximates that expected from simple classical diffusion, in the absence of strong convective currents. Analysis of the cesium metal diffusion profiles gives a diffusion coefficient and an activation energy of D_{Cs} (1000°C) = 7×10^{-9} cm^2/sec and Q = 27 kcal/mole, respectively. (auth)

29188 (GULF-GA-A-12667) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1973. (Gulf General Atomic Co., San Diego, Calif.). 31 Jul 1973. Contract AT(04-3)-633. 44p. Dep. NTIS $4.25.

The research and development program for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor is reviewed. Studies of component development, such as auxiliary equipment and special tools, and nuclear analysis of the fuel cycle, fuel zoning, and power shaping are included. The fuel development and fuel element proof testing programs include demonstration testing of the performance of test fuel elements by means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. Studies covering the components of the steam generator under operating conditions are included. Experimental procedures and results are discussed and, where appropriate, the data are presented in tables, graphs, and photographs. (auth)

29189 (GULF-GA-B-12472) EXTERNAL NEUTRON SOURCES FOR THE FORT ST. VRAIN, UNIT NO. 1 CORE. Malakhof, V. (Gulf General Atomic Co., San Diego, Calif.). 9 Feb 1973. Contract AT(04-3)-633. 79p. Dep. NTIS $6.00.

The external neutron source requirements for the startup of the Fort St. Vrain, Unit No. 1 Core were analytically derived. It was found that a total source strength of 3×10^9 n/sec was required. The source strength includes a factor of 2 for calculational uncertainties and assumes that the minimum desired detector count rate is 10 cps. Out of various available source types, Californium-252 sources were found to be most suitable for the HTGR environment. Two sources of equal strength will be placed in the uppermost layer of fuel elements in refueling regions 9 and 16. The sources are overlooked by the horizontal detectors located in the top head of PCRV. The apparent multiplication constant of the fresh initial core with all control rods inserted and at room temperature was 0.905, in good agreement with the eigenvalue calculations. (auth)

29190 (GULF-GA-B-12571) TEMPERATURE COEFFICIENTS FOR THE FSV INITIAL CORE. Marshall, A. C. (Gulf General Atomic Co., San Diego, Calif.). Mar 1973. Contract AT(04-3)-633. 38p. Dep. NTIS $4.00.

Temperature coefficients have been generated for the Fort St. Vrain (FSV) HTGR initial core. The calculational procedure used and the temperature coefficients obtained from these calculations are presented. Two methods for generating temperature coefficients were used. In one approach, flux weighted macroscopic cross sections from xy BUGTRI calculations were used in the RZ GAMBLE calculation. The GAMBLE diffusion theory calculations provided temperature coefficients at the beginning-of-cycle (BOC) for the critical rod positions from the cold core condition to operating temperature. Since these calculations were expensive to run, a more approximate and less costly calculation was made with the one-dimensional diffusion theory code TEMCO. It was found, for the rodded condition, that the temperature coefficients calculated by TEMCO could be brought into close agreement with the results from the more detailed calculations by reducing the control rod boron atom density. This reduction corrects the overprediction of the boron worth in the one-dimensional model. This adjusted one-dimensional model was then used to obtain isothermal temperature coefficients and fuel coefficients over a wide range of control rod configurations, temperatures, and xenon conditions at various times in core life. (7 references) (auth)

29191 (JUL-916-TP) EXPERIMENT ON HOT GAS ISOLATION WITH REGARD TO THE EFFORT IN THE HHT PLANT. 1. Problem Situation and Description of the goal of the Experiment. Bruners, R.; Kolb, F.; Lang, H.; Noack, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Jan 1973. 45p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

The objectives of a series of experiments for testing the hot gas piping in HHT plants. The experiments form part of the project "High-temperature reactors with a high-capacity helium turbine" and include dynamic tests in ARGAS, depressurization and static tests. The testing installations are described in detail. (GE)

29192 (ORNL-TM-4352) APPORTIONMENT OF ^{232}Th IN THE THREE PARTICLE STREAMS OF AN HTGR REACTOR. Munro, J. K. Jr. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

A method is given for determining how the total amount of ^{232}Th loaded into a high temperature gas-cooled reactor (HTGR) at the beginning of each fueling cycle is distributed among the three streams of heavy metals which constitute the fuel charge. The method is based on the assumptions that (a) the reactor contains a homogeneous thermal neutron flux distribution and (b) the ratio of neutron absorbing mass to fissile mass is constant for each stream throughout the life of the reactor. The fraction of total ^{232}Th in each of the streams is obtained in terms of the solution of a set of three simultaneous linear equations. The method is applied to results from calculations of a simulated history of fuel breeding and burning for an HTGR reactor. (auth)

29193 FORT ST. VRAIN: HIGH-TEMPERATURE GAS REACTOR. Elec. Light Power, E/G Ed.; 51: No. 17, 30-32(Sep 1973).

A description is given of the technical features and safety systems of the HTGR in the Fort St. Vrain nuclear power plant. The role of Public Service Company of Colorado and the background to the decision to build Fort St. Vrain are also described briefly. (DLC)

29194 SURFACE REACTIONS OF HTR HELIUM WITH TURBINE MATERIALS AND THEIR INFLUENCE ON CREEP BEHAVIOR. Huddle, R. A. U. (Organization for Economic Cooperation and Development, Dorchester, Eng.). pp 158-177 of Deposition and Corrosion in Gas Turbines. Hart, A. B. (ed.). London; Applied Science Publishers Ltd. (1973).

From international conference on deposition and corrosion in gas turbines; London, England (6 Dec 1972).

The corrosion behavior of metals in High Temperature Reactors (HTR's) is determined by the impurities in the helium coolant. These impurities, which in the Dragon Reactor Experiment (with a gas outlet temperature of the order of 700 to 750°C) total about 1 vpM at 20 atm pressure, comprise approximately 0.5 to 0.75 vpM H_2, 0.25 to 0.40 vpM CO, with H_2/H_2O, CO/CO_2, and H_2/CH_4 ratios in the range 10/1 to 100/1. At the oxygen potentials arising from this range of compositions and concentrations, metals such as Cr, Ti, and Al are oxidized, whereas Fe, Ni, and Co are reduced; a related pattern of carburization and decarburization behavior results from the carbon potentials. Surface films formed on the conventional austenitic high-temperature alloys at these oxygen potentials consist almost entirely of chromium oxide together with minor quantities of titanium, manganese, and aluminum oxides. The major objective of the programme is to study the influence of HTR helium on the stress/strain/time behavior of metals and alloys in the temperature range 350 to 1050°C; much of this data is relevant to HTR closed-cycle gas-turbine applications. The majority of the work was therefore directed to the provision of creep data in a controlled HTR helium environment. The effect of stress and its resultant strain is to modify the nature of the internal oxidation in such a manner that surface

cracking takes place. This in turn leads to increased strain rates, suggesting the occurrence of a "corrosion creep" phenomenon in some respects analogous to corrosion fatigue. Results obtained so far indicate that, in HTR helium, certain alloying elements, particularly Ti and to a lesser extent Al, stimulate corrosion creep, whereas W and Nb are inhibitors. (auth)

29195 SHIELDING FOR NUCLEAR REACTORS. Patarin, L.; Vivien, J. (to Commissariat a l'Energie Atomique). French Patent 2,147,773. 7 May 1971. 5p. (In French).

Shielding for high temperature reactors consisting of a vessel insulated from the reactor core and a coolant flowing across the vessel through a leak-tight skin is presented. It is in the form of prismatic elements stacked in vertical columns. A special feature is that at least some of the outer columns of the shielding are connected to the leak-tight skin of the vessel and that the prismatic elements are partly made of moderating material and partly made of absorbent material. (FR)

Power Reactors, Non-Breeding, Otherwise Moderated

29196 HEAVY WATER MODERATED NUCLEAR REACTOR. Costes, D. (to Commissariat a l'Energie Atomique). French Patent 2,147,778. 4 Jun 1971. 12p. (In French).

A new type of boiling water cooled and heavy water moderated nuclear reactor is proposed. It consists of a vessel which is resistant to the pressure of the cooling water, a calendria tank contained in the vessel and filled with heavy water, and vertical thin and heat conducting calendria tubes which cross the tank, these tubes containing the nuclear fuel which is cooled by a forced circulation of boiling water in the tubes. (FR)

Power Reactors, Breeding

Refer also to abstracts 27801, 27901, 29228, 29231, and 29270.

29197 (AI-AEC-13107) LMFBR PHYSICS PROGRAMS. Annual Technical Progress Report, Government Fiscal Year 1973. Alter, H.; Rose, P. F.; Hubner, R. S.; Alston, T.; Otter, J. M. (Atomics International Div., Canoga Park, Calif. (USA)). 24 Aug 1973. Contract AT(04-3)-824. 19p. Dep. NTIS $4.00.

Progress in the development of ENDF/B data files and analysis of benchmark assemblies for use in LMFBR design is reported. (JWR)

29198 (AI-AEC-13109) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Annual Technical Progress Report, Government Fiscal Year 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 28 Aug 1973. Contract AT(04-3)-824. 113p. AT.

The studies include radiation effects on Type 316 stainless steel, helium generation in ^{10}B and other reactor materials, control absorber heating experiments, and radiation effects on tantalum. (JWR)

29199 (AI-AEC-13111) LMFBR IN-VESSEL STORAGE REFUELING COMPONENT DEVELOPMENT PROGRAM. Annual Technical Progress Report, Government Fiscal Year 1973. Berg, G. E.; Bilibin, K.; Nelson, D. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Aug 1973. Contract AT(04-3)-824. 44p. AT.

Progress in the development and testing of handling devices for core components for an LMFBR plant with under-the-shield refueling and reactor vessel cover rotating plugs is reported. The devices include an in-vessel transfer machine, an ex-vessel transfer machine, an auxiliary handling machine, floor valves, and core component service equipment. (JWR)

29200 (GULF-GA-A-12635) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, February 1, 1973-April 30, 1973. (Gulf General Atomic Co., San Diego, Calif.). 15 Jun 1973. Contract AT(04-3)-167. 80p. Dep. NTIS $6.00.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program are program planning, core development, development of a pressure equalization system for fuel rods, fuels and materials development, and nuclear analysis and reactor physics. Core development work included thermal-hydraulic analyses of the fuel-rod assembly, structural analyses of the fuel-rod spacer grid support and of the blanket-element box wall, construction of the fuel-rod-spacer interaction test apparatus, and development of a calculation model to predict fuel-rod behavior. The status of the GCFR thermal- and fast-flux irradiation programs is given. The results to date of the analyses of fission-gas release data from the vented-fuel-rod GB-10 being irradiated in the ORR and of the fast-flux F-1 experiment are given. Reactor physics work was concerned with surveillance of LMFBR critical assembly experiments, comparison of GGA and ANL calculational methods for critical assembly analysis, and defining goals and requirements for GCFR critical experiments program. (auth)

29201 (RDT-C-4-7-T(6-73)) EDDY-CURRENT PROBE TYPE FLOW SENSOR FOR LIQUID METAL SERVICE. Division of Reactor Research and Development (AEC), Washington, D. C.). Jun 1973. 20p. RSO.

Requirements are established for performance, materials, fabrication, testing, packaging, delivery and quality assurance for eddy-current probe type flow sensors used to measure the liquid metal coolant flow within the reactor vessel and in test facilities. The flow sensors are installed in a protective thimble or sheath and do not comprise any part of the pressure-retaining boundary of the system in which they are installed. (FS)

29202 (RDT-C-10-5-T(2-73)) EDDY-CURRENT FLOW-METER POWER SUPPLY AND SIGNAL CONDITIONING ELECTRONICS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Feb 1973. 18p. RSO.

The requirements for design, fabrication, testing, and inspection of the electronics necessary for operation and maintenance of probe-type eddy current flowmeters used in LMFBR type reactors are presented. The electronics for current regulators, eddy current power supplies, signal conditioning electronics, and the test station, which is used to locate the source of a fault, and define the fault, are controlled by this standard. (FS)

29203 (RDT-E-1-11-T(7-73) RUPTURE DISK DEVICES FOR LIQUID METAL SYSTEMS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 13p. RSO.

Requirements for rupture disk devices for installation in inert gas or liquid metal systems and related facilities for protection against overpressure or leakage are provided. (FS)

29204 (RDT-E-13-16-T(4-73)) DRIVER FUEL ASSEMBLY. (Division of Reactor Research and Development (AEC), Washington, D. C.). Apr 1973. 14p. RSO.

The standard for the fabrication of fuel assemblies for fast flux, sodium cooled, nuclear reactors is presented. The fuel assembly, which is the basic nuclear power generating member of the reactor core, consists of fuel pins, duct tube assembly, axial shield/orifice assembly, inlet nozzle, and handling socket. (FS)

29205 (WARD-NA-3045-3(Pt.2)) INTERSTITIAL TRANSFER PROGRAM IMPACT ASSESSMENT REPORT. Part II. Program Justification and Scope. Shiels, S. A.; Schrock, S. L.; France, L. L. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 82p. AT.

Evidence for carbon and nitrogen transfer in sodium systems is presented together with an evaluation of the effect of these elements on the strength of Types 304 and 316 stainless steels as justification for the AEC sponsored program. The program scope and technical approach are briefly covered and the experimental results given. Of particular importance is the impact of the results on the ASME pressure vessel code as applied to liquid sodium systems. It is evident that some changes will be required for this special application. Design options to compensate for carbon and nitrogen loss are commented on with reference to FFTF and the Demonstration Plant. For longer term design such as commercial plants, further design needs are identified. Finally, an appendix is attached to the document which includes examples in the form of internal memos of estimates of interstitial transfer rates in FFTF/LMFBR components which have been supplied on request to FFTF/LMFBR design personnel over the last three years. Also, a report dealing with the effect of bulk carbon and nitrogen contents on mechanical properties is appended. (auth)

29206 (WARD-XS-3045-3) UTILIZATION OF INTEGRAL EXPERIMENTS AND RELATED DATA IN LMFBR DESIGNS. Dyos, M. W.; Paik, N. C. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.) Sep 1973. Contract AT(11-1)-3045. 20p. AT.

It was shown that experimental information concerning the nuclear performance of the Demonstration Plant can be obtained from the ZPPR critical assembly with plate geometry. Differences between the geometries of ZPPR and the Demonstration Plant appear to be amenable to calculation. Several discrepancies such as the pin versus plate reactivity effect in ZPPR-2, currently exist. These discrepancies, however, lie within the currently established limits of design conservatism. A summary of the results of the pin versus plate effects are given. A new evalua-

tion of delayed neutron data led to a reduction (5%) in the ih/% Δk conversion factor. Important implications of this reduced conversion factor are that agreements between measured and calculated central material worths and plate versus pin reactivity effects improve by 5%, whereas calculations of central sodium voiding and Doppler sample reactivities would be further underestimated by 5% in the plate assembly. Reaction rate ratios, pin versus plate ratios of sodium voiding and ratios of Doppler sample measurements analyses are not affected. (auth)

29207 REALIZING THE POTENTIAL OF THE BREEDER. Feathers, L. A. Combustion; 45: No. 2, 31-35(Aug 1973).

A non-fossil energy source is needed which is capable of supplying abundant low-cost energy in an environmentally acceptable manner. The LMFBR is the advanced nuclear system which meets these requirements and one which has been selected for development by most of the industrialized nations of the world. Much of the development work and costs are completed, and now is the time for an aggressive approach to getting commercial LMFBR's on the line. The strong interest and support of the utility industry is needed in order to attain early realization of the commercial breeder. An analogy can be drawn with the current LWR plants. Today, this industry is experiencing a rapid rate of growth, but this growth did not get started until the utility industry had acquired knowledge of the nuclear technology and the confidence to commit substantial investments to this new field. The commitment of the utility industry to the breeder—through the support of the Demonstration Plant and the follow-on program—must continue until the commercial LMFBR becomes a reality. With the interest and support of the utility industry, competitive commercial LMFBR's could be in operation before the end of the next decade—offering the beginning of a permanent solution to the nation's energy problem and the conservation of our fossil fuel resources for centuries to come. An aggressive approach to the development of the LMFBR is needed in order to avert a future energy crisis and to realize the maximum economic and environmental benefits of the breeder. (auth)

29208 NUCLEAR REACTOR. Sauvage, M. (to Commissariat a l'Energie Atomique). French Patent 2,138,327. 24 May 1971. 7p. (In French).

An improvement is described for fast neutron integrated type sodium cooled reactors. The roof of the tank is provided with a device which follows the variations in the temperature of the sodium in the tank, but does not in anyway modify the mechanical rigidity of the roof or modify any of its other properties. A coolant fluid circuit comprised of a first part, which is immersed in the sodium of the tank, and a second part rapidly fixed to the roof closing the tank is employed. The two parts are connected in series and respectively connected to the inlet and outlet collectors of the coolant fluid. This fluid may be sodium or a sodium–potassium mixture. (FR)

29209 ACOUSTICAL DETECTOR DEVICE FOR A SODIUM NUCLEAR REACTOR AND ITS CALIBRATION. Hanff, M.; Lions, N.; Peronnet, J. (to Commissariat a l'Energia Atomique). French Patent 2,150,572. 22 Jul 1971. 10p. (In French).

A device for detecting local boiling in a sodium nuclear reactor is presented together with a method for calibrating the device. The applications of this acoustical detector device are not limited to the detection of acoustical phenomena accompanying boiling. Cavitation, abnormal vibrations and all sound wave emitting phenomena within the sensitivity range and pass band limits of the apparatus can be detected. The detector is provided with an acoustical conductor in the form of a tube open at its lower end and immersed in the sodium, and a second acoustical conductor joined in series to the first and in the form of a solid rod extending to the outside of the reactor vessel. An accelerometer detects the signals from the second conductor, an amplifier enabling the signals detected to be fed into the measurement equipment. (FR)

29210 DEVICE ENSURING THE ISOLATION OF TWO FLUIDS AT DIFFERENT TEMPERATURES. Delisle, J. P.; Sauvage, M. (to Commissariat a l'Energia Atomique). French Patent 2,133,348. 16 Apr 1971. 6p. (In French).

A sealing device ensuring the isolation of a hot fluid flowing inside a tube connecting two vessels, from a cold fluid circulating outside this tube, is presented. The ends of the tube are provided with rounded bushes, each of these bushes being maintained at the temperature of the hot fluid, flowing freely into one of two sleeves having diameters slightly greater than that of the rounded bush. These sleeves are fixed to the walls of the vessels and maintained at the temperature of the cold fluid. The bushes permit a slight movement of the tube relative to the vessels. This device is particularly suitable for fast neutron integrated reactors in which the liquid sodium is stored in a primary tank after it has circulated through the reactor core, the sodium being subsequently led by pipes into the exchangers and the whole installation being immersed in cold sodium. (FR)

29211 NUCLEAR FUEL ASSEMBLY FOR FAST NEUTRON REACTORS. Cayol, A.; Chenal, J. C.; Clottes, G.; Schaller, K.; Skok, J.; Venobre, H. (to Commissariat a l'Energia Atomique). French Patent 2,136,901. 7 May 1971. 10p. (In French).

An improvement for nuclear fuel assemblies is presented. Such assemblies generally consist of at least one cluster of elongated clad fuel pins positioned parallel to one another in a regular lattice, and an envelope which defines a duct through which the coolant flows. Slits are provided which cut the dihedral angles of the envelope, these slits being made either perpendicularly or obliquely in relation to the axis of the assembly. A sleaving which is thinner than the envelope is interpositioned between the envelope and the cluster over at least part of the length of the envelope. In this way, the arc deformation of the assemblies at high levels of irradiation is eliminated or attenuated even in the regions of maximum radial flux gradient. (FR)

29212 NUCLEAR FUEL ASSEMBLY. Chenal, J. C. (to Commissariat a l'Energie Atomique). French Patent 2,146,976. 29 Jul 1971. 10p. (In French).

An improvement for the fuel assemblies of fast neutron sodium cooled reactors is described. Such assemblies generally consist of a cluster of elongated clad fuel pins positioned in a regular lattice in an envelope which defines a duct through which the coolant flows, the minimum space between each pin and its nearest neighbors being determined by helical spacers which run along most of the length of at least some of the pins. A flat structure comprised of two parallel metal sheets is interposed between the peripheral pins of the cluster and the envelope. This structure can be progressively squashed without rupturing under the pressure from the pins in the case of a differential swelling of the cluster in relation to the envelope. (FR)

29213 FUEL PIN ASSEMBLY. Chenal, J. C. (to Commissariat a l'Energie Atomique). French Patent 2,146,975. 20 Jul 1971. 9p. (In French).

An improvement for the fuel assemblies of fast neutron sodium cooled reactors is presented. Such assemblies generally consist of a cluster of elongated clad fuel pins positioned in a regular lattice in an envelope which defines a duct through which the coolant flows, the minimum space between each pin and its nearest neighbors being determined by helical spacers which run along at least most of the length of the pins. A sheet of corrugated metal presses against the inner wall of the envelope, the corrugations not being parallel with the pins. This liner determines the minimum space between the peripheral pins and the envelope and enables the mechanical stresses which could arise from the swelling of the pins to be reduced. (FR)

29214 NUCLEAR FUEL ASSEMBLY. Cayol, A.; Clottes, G.; Loriot, P.; Stok, J. (to Commissariat a l'Energie Atomique). French Patent 2,141,559. 16 Jun 1971. 11p. (In French).

A fuel assembly for liquid metal cooled breeder reactors is described. It consists of at least one cluster of clad fuel pins positioned in a regular lattice in an envelope which defines a duct through which the coolant flows. Helical spacers are provided along most of the length of the pins; these spacers determine the minimum space between a pin and its nearest neighbors or between the pins and the envelope. A special feature of the system is that the inner wall of the envelope is dished and that the spacers of the lateral pins of the cluster fit into the dishings. (FR)

29215 NUCLEAR FUEL ASSEMBLY. Chenal, J. C. (to Commissariat a l'Energie Atomique). French Patent 2,146,974. 29 Jul 1971. 7p. (In French).

An improvement to the fuel assemblies of fast neutron sodium cooled reactors is presented. Such assemblies generally consist of a cluster of clad fuel pins positioned in a regular lattice in an envelope which defines a duct through which the coolant flows, the minimum space between each pin and its nearest neighbors being determined by helical spacers which run along most of the length of the pins. Nonrigid tubes are interpositioned between the peripheral pins (which do not have spacers) and the envelope. In this way the minimum space between these pins and the envelope is fixed. The swelling under irradiation of the pins results in a pressure which distorts the straight parts of the tubes. It is necessary that the stresses developed do not exceed the rupture point of the material used. (FR)

29216 NUCLEAR FUEL ASSEMBLY FOR FAST NEUTRON REACTORS. Chenal, J. C.; Schallber, K.; Skok, J.; Venobre,

H. (to Commissariat a l'Energie Atomique). French Patent 2,148,375. 12 Aug 1971. 12p. (In French).

An improvement for the fuel assemblies of fast neutron sodium cooled reactors is presented. The reactors considered are provided with at least one cluster of elongated clad fuel pins, the pins being positioned parallel to one another in a regular lattice, and an envelope containing the cluster in which the coolant flows (generally in a direction parallel to the pins). The envelope of each assembly is provided with at least two parts which are positioned end to end and connected by a joint which extends over only part of the length of the assembly thus enabling the parts to move with respect to one another. In this way the arc deformation of the pins under high levels of radiation is reduced. (FR)

Research, Test, and Experimental Reactors

Refer also to abstracts 27484, 29205, 29206, and 29263.

29217 (ANL-8011) COMPATIBILITY OF CHROMIUM PLATING WITH THE EBR-II COOLANT. Ruther, W. E.; Taylor, H. A. (Argonne National Lab., Ill.). Apr 1973. Contract W-31-109-Eng-38. 8p. AT.

The compatibility of chromium plating with the EBR-II coolant was determined by two techniques. First, stainless steel components that had been chromium-plated were examined after years of exposure to primary sodium in the reactor. Second, a special subassembly was exposed in which a loss of chromium plating of as little as 10^{-6} in. could be detected by gravimetric means. In this subassembly, specimens plated to different thicknesses by a standard commerical electroplating process and by a proprietary "Electrolyzing" process were exposed to EBR-II primary sodium for 13 months. The results obtained by both techniques indicate that chromium plating is completely compatible with the flowing EBR-II coolant at temperatures at least as high as 845°F. (auth)

29218 (IITRI-578-TO-76-2) EFFECTS OF STEAM TUBE RUPTURE IN EBR-II SUPERHEATER. Final Report. Zaker, T. A.; Salmon, M. A. (IIT Research Inst., Chicago, Ill.). 30 Sep 1968. Contract AT(11-1)-578. 86p. Dep. NTIS $6.50.

For Argonne National Lab., IL.

The results of a study of the effects of steam tube rupture in a superheater of the EBR-II steam generator system are presented. Models were developed for estimating the rate of injection of steam into sodium on the shell side, for analyzing the sodium-steam reaction process under dynamic conditions, and for calculating the coupled response of the shell and unreacted sodium. The maximum flowrate of steam per unit area of break under the operating conditions of the superheater is found to be 18.9 lb/sec/in.^{2}. This value is attained in choked flow from a break in a tube at the steam inlet tube sheet. At superheater conditions the overall reaction between steam and sodium produces sodium monoxide and free hydrogen. The net heat evolved per unit mass of injected steam is 3140 Btu/lb. Tubes adjacent to a failed tube are exposed to a peak over-pressure of about 1000 psi within 0.3 msec after tube rupture. Thereafter, pressures in the superheater are controlled by the hydraulic response of the sodium pipe network. Analysis of the transient hydraulic response of the EBR-II secondary sodium network for steam leak rates up to 7 lb/sec shows that peak overpressures in the reaction-product gas bubble range up to 140 psi in excess of the static yield overpressure of the superheater shell. At the largest leak rate the super-heater shell sustains an unacceptably large circumferential strain of 4 percent. The existing pressure relief diaphragms in the circuit have no effect on pressures in the superheater until after the peak bubble pressure has occurred. (auth)

29219 (INR-1456) PHYSICAL AND GEOMETRICAL PARAMETERS OF ANNA CRITICAL ASSEMBLIES. Part II. Malewski, S.; Dabrowski, C. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 51p. Dep. NTIS (U. S. Sales Only) $4.75.

An extended analysis of four critical configurations of ANNA Assembly was performed. Diffusion parameters of the thermal group and of one or three epithermal groups were determined. Using these data critical calculations were carried out and the main neutron density distributions presented. The role of some neutron processes in these systems and their influence on integral parameters were considered. The calculated quantities are compared with the available experimental data. (auth)

29220 TRITIUM SOURCES AT THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Kunkel, W. P. (General Electric Co., Fayetteville, AR). pp 572-579 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

The presence of tritium at the SEFOR Facility is analyzed. The use of nitrogen gas, which blankets the primary system and also acts as a coolant for control reflectors and a biological shield located in the high neutron flux immediately surrounding the reactor pressure vessel, constitutes a tritium source for the SEFOR. Other sources of tritium in SEFOR are discussed. 7 references. (auth)

29221 AIRBORNE TRITIUM MONITORING NEAR A HEAVY WATER NUCLEAR REACTOR. Golchert, N. W.; Sedlet, J. (Argonne National Lab., IL). pp 579-585 of Tritium. Moghissi, A. A. (ed.). Las Vegas, NV; Messenger Graphics, Publishers (1973).

From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971). See CONF-710809-.

A portion of the Argonne Environmental Monitoring Program deals with tritiated water vapor in air. The measured tritium distributions on the Argonne National Laboratory site are consistent with the interpretation that the CP-S Reactor is the only significant localized tritium source in the area. The ANL CP-S Reactor is a heavy-water moderated and cooled research reactor with a maximum output of SMW. In the normal mode of operation, the concentration of tritium in the exhaust air is about 2μCi/m^3. Essentially all of this tritium is in the form of tritiated water vapor. (auth)

29222 25-keV NEUTRON FACILITY AT APSARA. Kondaiah, E.; Anand, R. P.; Bhattacharya, D. (Tata Inst. of Fundamental Research, Bombay). pp 507-511 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 15B. Bombay; Dept. of Atomic Energy (1972).

From nuclear physics and solid state physics symposium; Chandigarh, India (28 Dec 1972). See CONF-721231-.

Production and Materials Testing and Processing Reactors

Refer also to abstract 27484.

Propulsion and Package Reactors

29223 (AI-AEC-13067) SNAP PROGRAMS: SUMMARY REPORT. Staub, D. W. (ed.) (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jul 1973. Contract AT(04-3)-701. 208p. Dep. NTIS $7.60.

The overall SNAP Reactor Programs, covering the period from 1951 through 1973, is summarized. The following programs are reviewed: SNAP 2, SNAP 4, SNAP 8, SNAP 10A, 5-kW(e) Program, and the SNAP Reactor Aerospace Safety Program. (auth)

29224 (AI-AEC-13068) SNAP 2: SUMMARY REPORT. Jarrett, A. A. (Atomics International Div., Canoga Park, Calif. (USA)). 27 Jul 1973. Contract AT(04-3)-701. 192p. Dep. NTIS $7.60.

The development history of the SNAP 2 concept is presented. The program was originally oriented toward the development of a specific 3-kW(e) Mercury Rankine cycle system powered by a hydride reactor. Subsequently, the program was directed toward a broader technology development of the engineering feasibility of larger systems for space applications into the 100- to 200-kW(e) range. The initial critical assembly of the reactor concept, and the power, temperature, and life demonstration by the SNAP Experimental Reactor (SER) and the SNAP 2 Developmental Reactor (S2DR) are described. The development of components of the power conversion system, called the combined rotating unit (CRU), which has all rotating components mounted on a single common shaft, is summarized. Other major component developments described are: (1) the mercury boiler-superheater, (2) the radiator-condenser heat rejection system, and (3) the thermo-electromagnetic pump. In addition, the development and status of other components required for startup, steady-state operation, shutdown, and restart are described. System testing is summarized which demonstrated compatibility, structural integrity, and zero gravity characteristics. Potential applications of the Mercury Rankine system are presented. (auth)

29225 (AI-AEC-13079) ZIRCONIUM HYDRIDE REACTOR CONTROL SYSTEM BEARING DEVELOPMENT: SUMMARY REPORT. Horton, P. H.; Kurzeka, W. J. (Atomics International

Div., Canoga Park, Calif. (USA)). 14 Jun 1973. Contract AT(04-3)-701. 115p. Dep. NTIS $5.45.

The technical history and development of bearings for the various SNAP reactor programs are traced from initial material selection through life testing and reactor operation. A reference bearing couple of flame-sprayed Al_2O_3 against carbon-graphite has successfully operated in individual tests of 20,000 hours and through a combined total of more than 120,000 hours. The self-aligning journal bearing design has provided low friction operation in temperatures to 1500°F in space vacuum (to 10^{-9} torr) without self-welding after long dwell periods. A variety of Al_2O_3 substrates have been used successfully for component requirements between 800 and 1500°F including Type 300 series stainless steels, Inconel-750, and tantalum–10% tungsten alloys. (auth)

29226 (AI-AEC-13096) 5-kWe REACTOR THERMOELECTRIC SYSTEM: SUMMARY. Van Osdol, J. H. (ed.) (Atomics International Div., Canoga Park, Calif. (USA)). 27 Jul 1973. Contract AT(04-3)-701. 216p. (NASA-CR-12141). Dep. NTIS $7.60.

Design of the 5-kW(e) Reactor Thermoelectric System was initiated in February 1972 and extended through the conceptual design phase into the preliminary design phase. Design effort was terminated in January, 1973. The system and component requirements, design approaches, and performance and design characteristics for the 5-kW(e) system are described. Included is summary information on the reactor, radiation shields, power conversion systems, thermoelectric pump, radiator/structure, liquid metal components, and the control system. (auth)

29227 (NAA-SR-Memo-9946) SNAPTRAN V CORE-FUEL ELEMENT DATA PACKAGES. (Atomics International, Canoga Park, Calif.). 14 May 1964. 156p. Dep. NTIS $10.00.

Certification, test and inspection results and copies of all waivers for the thirty-seven (37) SNAPTRAN V fuel elements are given. In addition, some pertinent aspects of the test and inspection operations are discussed. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 27304, 27343, 27660, and 29430.

29228 (AI-AEC-13108) LMFBR SAFETY PROGRAMS. Annual Technical Progress Report, Government Fiscal Year 1973. Koontz, R. L.; Johnson, R. P.; Nelson, C. T.; Baurmash, L.; Vaughan, E. U.; Heisler, M. P.; Springer, T. H.; Silberberg, M. (Atomics International Div., Canoga Park, Calif. (USA)). 20 Aug 1973. Contract AT(04-3)-824. 33p. Dep. NTIS $4.00.

Studies on the characterization of sodium fires and fission products included two-cell sodium pool burning tests, uranium oxide–sodium oxide aerosol tests, resuspension studies, and analysis of gas circulation effects for an improved sodium fire model. (JWR)

29229 (BAW-10065) MULTINODE ANALYSIS OF B AND W's 205-FUEL-ASSEMBLY (MARC-C DESIGN) NUCLEAR PLANTS DURING LOSS-OF-COOLANT ACCIDENT. Parks, C. E.; Dunn, B. M.; Shah, N. H. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Jul 1973. 96p. Dep. NTIS $7.00.

Multinode analyses were conducted to evaluate several loss-of-coolant accidents for B&W's nuclear plants with 205 Marc-C fuel assemblies. The multinode blowdown code CRAFT, the reflooding code REFLOOD, and the cladding heatup code THETA1-B were used to perform these analyses at a core power of 3760 MW(t). Curves showing the parameters of interest are presented. Results of the analyses indicate that the emergency core cooling system will terminate the cladding temperature transient and limit the course of the LOCA in accordance with the AEC Interim Acceptance Criteria. (auth)

29230 (CENPD-98) COAST CODE DESCRIPTION. Daleas, R. S. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). 2 Apr 1973. 39p.

COAST analyzes the reactor coolant flow in a two loop-four pump plant and the flow coastdown transient for any combination of active and inactive pumps including forward and reverse flow in any section. Individual loop flow rates and steam generator pressure drops are calculated as a function of time following coastdown of any number of reactor pumps. Conservation equations of mass and momentum are solved for the fluid stream in each loop in conjunction with a torque balance on each pump. (FS)

29231 (CLM-RR/S-2/1) NATURAL CONVECTION IN THE SODIUM FILLED SPACE SURROUNDING THE "CATCHER" FOR A FAST REACTOR. Whipple, R. T. P. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). 1972. 32p. (CPG/SRD-(72)P-4). Dep. NTIS (U. S. Sales Only) $3.75.

Speculations concerning the effectiveness of natural convection in liquid sodium surrounding the melted remains of the core of a fast reactor which has been caught in a "catcher" but is still producing about 10 M watts of heat through fission product decay are presented. If H is the heat production, k the thermal conductivity, l a length characterising the size, and ΔT the temperature difference between the hottest part of the catcher and the walls of the container, the Nusselt number is defined as $Nu = (H/kl)\Delta t$). If α is the expansion coefficient, $\lambda = (k/\rho C)$, and ν is the kinematic viscosity, it is desired to find a relation between Nu and the Rayleigh number $Ra = (l^3\alpha g\Delta T/\nu\lambda)$. For H = 100 MW and $l \sim 1$ metre, $R_a \simeq 10^8\,\Delta T$. If $R_a < 1$, Nu is determined by thermal conduction and $Nu \sim 1$. This case certainly does not apply. If R_a is moderate, the flow should be laminar. Near the end of this range, boundary layer theory should be applicable. It is shown that in this range $Nu \propto R_a^{\frac{1}{4}}$. If R_a is sufficiently large the flow will become turbulent. For fully developed turbulence $Nu \propto R_a^{\frac{1}{3}}$. (auth)

29232 (CLM-RR/S-2/2) EXPERIMENTS ON CONVECTION WITH INTERNAL HEAT SOURCES. Peckover, R. S. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Dec 1972. 17p. (CPG/SRD-(73)P-1). Dep. NTIS (U.S. Sales Only) $3.00.

Previous experimental work on Rumford convection in long vertical cylinders and in shallow horizontal layers is surveyed and the methods used compared. The experiments of Kulacki and Goldstein cover the range $0 < Ra_H < 10^7$ very satisfactorily for the configuration of most relevance to lumps of core upon a core-catcher. This corresponds to the laminar and weakly turbulent regimes. The prediction of heat fluxes for $Ra_H > 10^{10}$ when the convection is highly turbulent requires further experimentation. (auth)

29233 (HEDL-TME-73-61) PRESSURE WAVE TRANSMISSION IN A FLUID CONTAINED IN A PLASTICALLY DEFORMING PIPE. Fox, G. L.; Merckx, K. R. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 26p. Dep. NTIS $4.00.

Pressure wave propagation in a fluid filled pipe has been investigated when the wall undergoes plastic deformation. Results show that any pressure pulse sufficient to cause plastic deformation will travel at substantially reduced velocities. This allows unloading waves that normally occur with transient pulses to overtake and dissipate pressures above yielding. Thus, only pressures which cause elastic deformation will propagate long distances along a pipe. (auth)

29234 (MRR-123) EVALUATION OF TIME-DEPENDENT HEAT TRANSFER COEFFICIENTS FROM EXPERIMENTAL DATA ON A TUBE WITH INTERNAL FLOW. Istenic, R. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1973. 68p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Experimental data of internally flooded single tube (representing a hot channel of a PWR core) tests under simulated low pressure emergency-core-cooling conditions have been evaluated with regard to the time-dependent heat transfer coefficients. The characteristic time-averaged heat transfer coefficients have been plotted against the test parameters. The effects of the variable test parameters on the smoothed heat transfer coefficient transients have been investigated. (auth)

29235 (NP-tr-1947) STUDY OF POSSIBLE DESIGNS FOR WATER INTAKE AND OUTLET SYSTEMS OF LARGE THERMAL POWER STATIONS TAKING INTO CONSIDERATION SITE SUITABILITY. Lebreton, J. C.; Bonnefille, R. Translated by G. H. Wheelhouse from Houille Blanche; 27: No. 2/3, 199-103 (1972). 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Design problems of power plants which require large water intake and outlet systems are outlined, and considered in relation to hydrological aspects of waste water disposal, particularly flow rate. Thermal, hydraulic, and sedimentological phenomena in estuaries are considered with respect to their effects on the ecology. Plants in coastal areas present water disposal problems such as the swell of the sea. This effect and associated silt movement are discussed in relation to the siting of intake and outlet pipes. Lagoon sites are given special consideration. Problems of reliable access of water to lagoons under all circumstances make intake inadvisable from lagoons. Port sites are thought to present least difficulty, at least from the aesthetic viewpoint, and the fact that intake and outlet system problems can be more easily solved where docks or basins are available. (AT)

29236 (WCAP-7558) SEISMIC VIBRATION TESTING WITH SINE BEATS. Morrone, A. (Westinghouse Electric Corp., Pittsburgh, PA). Oct 1971. 53p. Dep. NTIS $4.75.

The adequacy of sine beat motion for testing building supported equipment, such as electrical and control equipment, was shown by comparing the resonant response amplifications given by various sine beat motions with those given by floor time-histories derived from actual earthquake accelerograms. Single degree-of-freedom oscillators with different damping values were used to develop earthquake floor time histories. Sine beats containing both five and ten cycles per beat were utilized. It is concluded that a ten cycle sine beat is sufficiently severe to cover almost all applications for testing equipment supported on higher floors of buildings. For lower floors, a smaller number of cycles per beat is applicable. (FS)

29237 MODERN DESIGN OF THERMAL POWER PLANTS. Zerna, W. Combustion; 5: No. 3, 35-41(Sep 1973).

For the design of buildings all significant loading conditions must be known. Therefore the unconventional loading conditions as they occur in natural draft cooling towers and nuclear power plants and which lead to new designs are described. The loads discussed are wind loads for cooling towers and outside explosions, airplane crashes, and earthquakes for nuclear power plants. All these loads affect the buildings dynamically. In nuclear power plant designs they are allowed to load a structure to its limit under such very low-probability catastrophies. Therefore, for these cases new safety factors and allowable stresses must be established. The design of buildings for nuclear power plants in the future must be able to solve all these problems much better than presently possible. Without doubt, better and more economical designs can be found for these structures which have to be able to withstand the herein discussed loading conditions. In consideration of the ever increasing cooling water shortage for power plants and the ever increasing power plant unit size, the idea of placing a nuclear power plant inside a very large dry cooling tower becomes more and more acceptable. The advantages of such a plant layout are obvious: lesser overall area requirement, short cooling water lines and separation of the various loads affecting cooling tower and reactor building. It appears worthwhile to study this plant design in greater detail. (auth)

29238 APPLICATION OF MECHANICAL SYSTEMS TO ALLEVIATION OF INTAKE ENTRAPMENT PROBLEMS. Riesbol, H. S. (Bechtel Inc., San Francisco); Gear, P. J. L. pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The alleviation of fish entrapment problems at circulating water intakes is viewed primarily as the development of protective systems that provide optimum combinations of mechanical components taking into account the interactions with biological, physical, hydraulic, location and site functions. A systems evaluation of the specific factors that apply to a selected site will result in a "best solution" to meet the environmental and engineering requirements and criteria applicable to that site. The definition of the specific factors at each site requires the collection and interpretation of adequate basic data to include: underwater topography; variations in water level; velocity; direction and magnitude of flows; tidal currents and wave action; water temperature and salinity; changes in ambient water as it passes through the circulating systems; characteristics of the ecosystem such as fish population, species and size range, and the presence and effect of other organisms. 20 references. (auth)

29239 ENVIRONMENTAL CONSIDERATIONS OF OFFSHORE NUCLEAR POWER PLANTS. Wright, J. H. (Westinghouse Electric Corp., Pittsburgh). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Offshore, platform-mounted nuclear power plants may provide significant economic and environmental advantages in comparison with power plants located at conventional sites. The specific types of environmental effects associated with the offshore plant are essentially the same as those effects from plants sited on shore; the significant difference is in the fact that the magnitude of these common problems is considerably reduced in deeper, offshore waters. (auth)

29240 ENVIRONMENTAL PROTECTION AGENCY RESEARCH PROGRAMS IN DETERMINING IMPACT OF NUCLEAR PLANT OPERATION ON WATER QUALITY. Attaway, L. D. (Environmental Protection Agency, Washington, DC). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The research programs of the EPA concerning the impact of nuclear plant operation on water quality are reviewed. The research programs include studies on the physical aspects of thermal pollution, aquatic biota in a freshwater environment, and analysis of marine environment.

29241 HEATED EFFLUENT DISPERSION IN LARGE LAKES: STATE OF-THE-ART OF ANALYTICAL MODELING, SURFACE, AND SUBMERGED DISCHARGES. Policastro, A. J. (Argonne National Lab., IL). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The published literature on analytical modeling of thermal discharges into large lakes is reviewed. Both surface and submerged discharges (single port and multi-port diffusers) are considered. The major characteristics of thirty-one surface discharge models are summarized; also, the general methods of modeling such discharges are reviewed. Comparisons with field and hydraulic data are summarily discussed for each model. Recommendations for future research are given. Recommended models for various submerged discharge situations are given when the design configuration is a single round or slotted port. Previous verification of those models is noted in tabular form. Analytical models for two common configurations of a submerged multi-port diffuser are briefly reviewed. Results of pertinent hydraulic model studies which may be used predictively are also included. A brief list of a few likely physical situations is given for which no published models exist. A comparison is made between the capabilities of a surface discharge and a submerged multi-port diffuser for a typical lake discharge situation. The physical characteristics of the two thermal plumes are compared. In an attempt to relate the review of analytical models to real world situations, ten power plant discharge designs (five surface and five submerged) are summarized and the models which may be applied predictively to these situations are noted. (auth)

29242 NUCLEAR PLANT SITING ON COASTAL AREAS IN CALIFORNIA. Adams, J. R. (Pacific Gas and Electric Co., Emeryville, CA). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Restrictions on the siting of nuclear power plants on the coast of California are reviewed. Cost-benefit data are presented for alternate cooling systems for the Diablo Canyon Power Reactor Units 1 and 2. (DCC)

29243 NUCLEAR PLANT SITING ON RIVERS. Abood, K. A.; Lawler, J. P.; Konrad, K. A. (Quirk, Lawler and Matusky Engineers, Tappan, NY). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The effects of thermal effluents from nuclear power plants on the aquatic environment of rivers are analyzed. Flow models of power reactor discharge systems are presented to minimize any adverse effects. 12 references. (DCC)

29244 USE OF COOLING LAKES FOR NUCLEAR POWER PLANTS. Hoveke, G. F. (Sargent and Lundy, Chicago). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

The operation of cooling lakes for the dispersion of thermal effluents from nuclear power plants is described. The heat dissipation efficiency of cooling lakes is analyzed. (DCC)

29245 WATER QUALITY CRITERIA, 1972: SUMMARY OF NATIONAL ACADEMY STUDY AND IMPLICATIONS FOR NUCLEAR POWER PLANTS. Coutant, C. C. (Oak Ridge National Lab., TN). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Water quality criteria concerning nuclear power plants effluents are reviewed. The effects of nuclear power plant thermal and chemical effluents on aquatic ecosystems are analyzed. 8 references. (DCC)

29246 REACTORS. pp 216-271 of Environmental Radioactivity. Eisenbud, M. New York; Academic Press, Inc. (1973).

The physics and engineering aspects of nuclear reactors are reviewed. Different types of reactors are described. Radioactive wastes from different reactor types are compared. Reactor accidents are discussed. Site selection criteria for power reactors are reviewed. The development of nuclear rockets is discussed briefly. (DCC)

Reactor Theory and Calculation

Refer also to abstract 29246.

29247 (BAW-10072) SAVER: DIGITAL COMPUTER CODE TO DETERMINE PRESSURE DROPS. Galan, V. J.; Brantley, J. T. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jul 1973. 38p.

The SAVER code calculates the steady-state flow and pressure drop in all paths of an arbitrary flow network. SAVER calculates elevation and momentum recoverable pressure drops and the types of unrecoverable pressure drops encountered most often. The pressure drop in each path is the sum of the elevation, momentum, and unrecoverable pressure drops. The momentum and unrecoverable pressure drops are expressed as $R \times W^2$, where R is the resistance to flow and W is the flow rate. The elevation pressure drop is not a function of flow rate. The elevation pressure drop and the resistances to flow are calculated using the B&W standard methods. A set of flow and pressure drop equations is written using these values. First, N-1 flow balance equations are written, where N is the number of flow path junctions in the network. Then, all the unique pressure drop balance equations are written, considering that the pressure drop across each path through the network must equal the pressure drop imposed by the boundary conditions. These equations are then solved for the flow rate in each path. Since there are generally more equations than unknowns, an iterative solution is necessary. (auth)

29248 (KFK-1821) REVIEW OF CURRENT PROBLEMS FOR MULTIDIMENSIONAL REACTOR STATICS CALCULATIONS. Froehlich, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jun 1973. 69p. Dep. NTIS (U.S. Sales Only) $5.50.

An attempt is made to place the current mathematical and computational methods development efforts into an appropriate perspective by giving a short review about the accuracy requirements and present capabilities of predicting physical parameters for fast and thermal reactors. The mathematical properties of the neutron transport and diffusion equations and of their exact solutions are considered and their relevance to the development of numerical methods is sketched. The theoretical foundation of numerical solution methods is discussed. Typical computational difficulties based on characteristic physics properties of various reactor types are presented and the benefits, difficulties, and the reliability of several computational methods are reviewed. In addition, new methods and possible future trends are discussed. Finally some of the outstanding mathematical and computational problems for fast and thermal power reactor calculations are mentioned. (auth)

29249 (ORNL-tr-2721) NUCLEAR FUEL MODEL, PHASE 2 PROGRAM NFM. Lurf, G.; Ruckelshaussen, K. Mar 1973. Translated from German. 66p. Dep. NTIS $5.50.

The NFM program for the calculation of burnup and fuel replacement in light water reactors is described. Some sample calculations for the KRB reactor are presented. (JWR)

29250 (WARD-XS-3045-2) PHYSICS EVALUATIONS AND APPLICATIONS. Quarterly Progress Report for Period Ending July 31, 1973. Durston, C.; Davis, W.; Paik, N. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug 1973. Contract AT(11-1)-3045. 18p. AT.

Activities in nuclear data evaluation and cross section processing code development for fast reactor calculations are reported. Neutron cross section evaluations of ^{238}U were extended to 20 MeV for ENDF/B IV. The SPHINX code for processing of cross sections was completed. (JWR)

29251 CENTRALE NUCLEARE-ELECTRICE. (Nuclear Power Plants). Danila, N. Bucharest; Editura Academiei Replublicii Socialiste Romania (1973). 776p. Lei 52.

The book presents the theoretical principles and engineering problems of nuclear power plants and is based on the synthesis of the works carried out abroad and in Romania, as well as on author's original work. The nine chapters of the book systematize comprehensive data pertaining to the design, construction and operation of nuclear power plants. (auth)

Reactor Components and Accessories

Refer also to abstracts 27031, 27032, 27178, 27550, 27807, and 27902.

29252 (RDT-C-4-8-T(8-73)) ORIFICE ASSEMBLIES FOR NUCLEAR SYSTEMS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Aug 1973. 16p. RSO.

Requirements for orifice assemblies constructed in accordance with ASME Boiler and Pressure Vessel Code and additional restrictive requirements are delineated. The orifices measure or restrict flow rate in nuclear piping systems containing gas, liquid metal, or other fluids. The standard does not apply to reactor core components. (FS)

29253 (RDT-C-15-5-T(12-71)) FISSION TYPE NEUTRON DETECTOR ASSEMBLY. (Division of Reactor Research and Development (AEC), Washington, D. C.). Dec 1971. 47p. RSO.

Requirements for an electrically guarded neutron detector measurement of the neutron flux level from shutdown to full power are provided. The detector is used to detect individual neutrons in neutron flux levels from 1 to 10^6 nv in the presence of incident gamma flux of 10^6 R/hr. Nominal counting sensitivity is 0.7 cps/nv. The detector can also be used as a wide range neutron detector in conjunction with mean square voltage circuitry over a range of 10 to 2×10^{10} nv in the presence of incident gamma flux of 10^6 R (hr). Mean square neutron sensitivity is $\sim 10^{-10}$ V^2/nv with a dc neutron sensitivity of 1.2×10^{-13} A/nv. The detector is 3 in. in dia and 14 in. long and can be operated continuously at temperatures up to 350°F. The assembly is a fission type detector with removable cables or optional integral cables, and optional electrostatic shield can and cable conduit. (FS)

29254 (RDT-F-6-2-T(7-73)) WELDING OF REACTOR CORE COMPONENTS AND TEST ASSEMBLIES. (Division of Reactor Research and Development (AEC), Washington, D. C.). Jul 1973. 55p. RSO.

Requirements for welding and for the evaluation of welds for replaceable reactor core components and test assemblies are provided. Core components consist of the driver fuel, control rod, and radial reflector assemblies. The test assemblies consist of components requiring special closure welds. The standard defines welding procedure qualification and performance qualification of welders, welding operators, welding equipment, and special fixturing for fuel pin, absorber pin, test assemblies, wire wrap welding and all other welds used in the replaceable core component assembly. (FS)

29255 COOLING SYSTEM OPTIONS: ECONOMIC AND ENVIRONMENTAL CONSIDERATIONS. Lee, B. Jr. (Commonwealth Edison Co., Chicago). pp vp of Water Quality Considerations: Siting and Operating of Nuclear Power Plants. New York; Atomic Industrial Forum, Inc. (1972).

From water quality considerations: siting and operating of nuclear power plants conference; Washington, District of Columbia, USA (1 Oct 1972). See CONF-7210105-.

Cooling systems available to nuclear power plants for dissipating waste heat to the environment are described. System costs and system efficiency are analyzed. (DCC)

29256 VERY LARGE HYPERBOLIC COOLING TOWERS. Furzer, I. A. (Univ. of Sydney). Mech. Chem. Eng. Trans.; MC8: No. 2, 122-124(Nov 1972).

A method is given for obtaining the dimensions of a hyperbolic cooling tower using a modern theory. A computer program calculates a wide range of design variables so that a minimum cost function can be evaluated. A single cooling tower 152 m in height and diameter could handle the thermal load of a 1000-MW power station. (auth)

29257 SYSTEM FOR CLOSING A PRESTRESSED CONCRETE VESSEL. Costes, D. (to Commissariat a l'Energie Atomique). French Patent 2,142,822. 25 Jun 1971. 6p. (In French).

A system for closing the opening of a prestressed concrete vessel is described in which a plug is provided, which fits into the opening of the vessel, a pressure seal being made on a shoulder formed in the upper part of the vessel wall for this purpose. A special feature is that a series of movable shims are positioned around the entire periphery of the plug. These shims, which possess gripping parts, are positioned obliquely

on the axis of the vessel; the end parts of each of these shims press, respectively, against part of the machined surface of the outer upper periphery of the plug, and against part of the machined surface of the inner lower periphery of a prestressed concrete ring elastically attached to the vessel by a system of prestressed sliding armatures. In addition, means are provided for ensuring the lifting up of the ring in relation to the vessel and the freeing of the shims. (FR)

29258 ELECTRIC GRAPNEL FOR CARTRIDGES. Briot, P.; Palomo, G. (to Groupement Atomique Alsacienne Atlantique). French Patent 2,137,015. 11 May 1971. 5p. (In French).

An electric grapnel for manipulating cartridges in the channel of a reactor in which the gas flow takes place in the opposite sense to the penetration of the grapnel in the reactor is described. The device consists of a gripping part maintained in the working position by a locking plate The grapnel is provided with a hemispherical dome part at its base together with a guard ring. The pressure of the locking plate when in the working position is transmitted to the hemispherical dome part. A means is also provided for eliminating the longitudinal movement of the gripping device. In this way the effects of vibrations, which tend to randomly open the gripping part, are avoided. (FR)

29259 ELECTRICAL PENETRATION ASSEMBLIES IN CONTAINMENT STRUCTURES FOR NUCLEAR FUELED POWER GENERATING STATIONS. New York; Institute of Electrical and Electronics Engineers (1971). 11p. (ANSI-N45.3).

Criteria for the mechanical, electrical, and test requirements for the design, construction, and installation of electrical penetration assemblies in containment structures for stationary nuclear fueled power generating stations are presented. The electrical conductor and insulation characteristics of external circuits which connect to penetration assemblies are beyond the scope of these criteria. (JWR)

29260 CLEANING OF FLUID SYSTEMS AND ASSOCIATED COMPONENTS DURING CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. New York; American Society of Mechanical Engineers (1973). 16p. (ANSI-N-45.2.1/1973).

Standards for on-site cleaning of materials and components, cleanness control, and preoperational cleaning and layup of important nuclear power plant fluid systems during construction are presented. The standard covers requirements necessary to ensure an adequately clean system upon completion of construction activities, and covers the period from which the materials and equipment are removed from storage or receiving for installation at the construction site until the systems are ready for pre-operational testing. (JWR)

29261 INSERVICE INSPECTION OF NUCLEAR REACTOR COOLANT SYSTEMS. New York; American Society of Mechanical Engineers (1971). 24p. (ANSI-N45.1).

29262 RULES FOR INSERVICE INSPECTION OF NUCLEAR REACTOR COOLANT SYSTEMS (SUMMER 1971 ADDENDA TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION XI, 1971). New York; American Society of Mechanical Engineers (1971). 22p. (ANSI-N45.1a).

Reactor Fuels

Refer also to abstracts 27535, 27707, 27711, 27712, 27715–27717, 27735, 27737, 27740, 27743, 27759, 27763, and 27764.

29263 (IDO-16964) TRANSIENT TESTS OF THE FULLY ENRICHED, ALUMINUM PLATE-TYPE, B CORES IN THE SPERT I REACTOR: DATA SUMMARY REPORT. Wing, A. P. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jun 1964. Contract AT(10-1)-205. 91p. Dep. NTIS $2.00.

Experimental data from three series of tests performed in the Spert I reactor with light water moderator and fully enriched fuel is presented. The tests consisted of step-wise insertions of excess reactivity under varying conditions ranging from ambient temperature to ≈96°C. The data obtained from these tests are presented in tabular form and as plots of the time behavior of reactor power and fuel plate surface temperature. Summary data figures displaying measured test data as functions of asymptotic reactor period are also included. (auth)

29264 (NP-tr-1948) CONVECTIVE HEAT TRANSFER IN AXIAL FLOW TUBE AND ROD BUNDLES. Markoczy, G. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1971. Translated by I. A. Mumme (Australian Atomic Energy Commission Research Establishment, Lucas Heights) from German. 91p. Dep. NTIS (U. S. Sales Only) $6.75.

Convective heat transfer in tubes and rod bundles was theoretically and experimentally studied under forced axial turbulent flow. It was shown that heat transfer coefficients under these complex conditions could not be determined by means of geometry-dependent correction functions. Therefore, new relationships were developed which described with sufficient accuracy local heat transfer in bundles of various arrangements. Two mathematical procedures were developed and tested on 2000 experimental measurements. The first one is an involved analytical procedure, while the second is simple and semi-empirical. (68 references) (auth)

29265 FILLING APPARATUS FOR NUCLEAR FUEL PELLETS OR THE LIKE. Hotz, K. (to Siemens Aktiengesellschaft). US Patent 3,746,190. 17 Jul 1973. Priority date 9 Dec 1969, F. R. Germany. 4p.

A filling apparatus is described for inserting material in pellet form into long envelope tubes. The pellets have a diameter that insures a close fit with respect to the inner wall of the envelope tube which has a magazine for holding a large number of stacks of the pellets and a guide structure connectable to the magazine for holding and guiding the stacks individually. An insertion mechanism is located near the guide structure for inserting the stack contained in the guide structure into one of the envelope tubes to be filled. The insertion mechanism includes a tubular housing, a pusher-slider in the housing, and a drive device which engages the pusher for reciprocally moving the pusher to transfer the pellet stack from the guide structure into the envelope tube. (Official Gazette)

29266 NUCLEAR FUELS: PRESS DOCUMENTATION. Nucleus (Bonn); 19: No. 15-16, 123-135(1973). (In German).

The international situation in the uranium market as well as in the news market cannot be reconciled. Reports from the main cities contradict each other. Important voices of the press during the time from Feb. to Dec. 1973 reflect the contradiction. Primarily, the European supply of enriched uranium is dealt with. (GE)

29267 NUCLEAR MATERIAL CONTROL SYSTEM FOR NUCLEAR POWER REACTORS. Columbus, OH; Institute of Nuclear Materials Management (1973). 13p. (ANSI-N15.8). American National Standards Institute, New York.

Requirements are presented for the control of special nuclear material in the facilities of nuclear power reactors where such material is used in the production of electrical energy. The materials involved in such a facility are uranium and plutonium of various isotopic content. The nuclear material control system involves the establishing of receipts from the shipper, three internal material balance areas, and records of shipments to a reprocessor as the means of maintaining control and accountability of all leased or owned special nuclear materials. (JWR)

Reactor Control Systems

Refer also to abstract 29188.

29268 (GULF-GA-A-12700) HTGR GAS TURBINE POWER PLANT CONTROL, SAFETY, AND MAINTENANCE STUDIES, PHASE II. Semiannual Progress Report, January 1, 1973–June 30, 1973. (Gulf General Atomic Co., San Diego, Calif.). 15 Aug 1973. Contract AT(04-3)-167. 177p. Dep. NTIS $11.00.

The results of control, safety, and maintenance studies for the high-temperature gas-cooled reactor (HTGR) gas turbine power plant are presented. A reference control system incorporating compressor bypass and reactor outlet temperature control has been established. Details of the plant steady-state and transient performance have been studied, using improved compressor and turbine performance maps. Helium inventory variation to control plant output has also been assessed. Completed studies of the turbomachinery startup and shutdown indicate that it is feasible to use the main electric generator as a startup motor; the maximum starting power has been assessed. Regions of potentially unstable operation during startup have been identified. HTGR gas turbine power plant emergency cooling has been analyzed using only the auxiliary cooling system and also in conjunction with the main loops. Cooling after primary system depressurization has also been evaluated. Analysis of the effects of earthquakes on the HTGR gas turbine power plant indicates that the resultant forces and displacements can be tolerated by the system components. Preliminary studies of rapid flow transients following a duct rupture accident or a loss of load have been conducted with a simple general-purpose computer program developed for this purpose. Studies of maintenance problems and handling procedures for the radioactive turbomachinery have been conducted. Prelimi-

nary handling equipment designs and a preliminary maintenance plan have been completed. (17 references) (auth)

29269 (ORNL-TM-4191) INVERSE KINETICS MEASUREMENTS USING THE SRM DETECTOR SIGNAL AT QUAD CITIES UNIT 2. Sides, W. H. Jr.; Bullock, J. B. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

A preliminary investigation was made to determine whether the signal from a source range monitor would be useful as an input to an inverse kinetics calculation of reactivity. The results indicate general agreement between calculated values and those observed with instruments and encourage further investigation. (auth)

29270 (RDT-E-6-33-T(5-73)) CONTROL ROD ASSEMBLY FOR LIQUID METAL FAST REACTORS. (Division of Reactor Research and Development (AEC), Washington, D. C.). May 1973. 14p. RSO.

The requirements for fabrication, testing, and inspection of control rods for LMFBR's are provided. (FS)

Nuclear Power Plant Economics

Refer also to abstracts 29251 and 29384.

29271 (CONF-730559-1) NUCLEAR SOURCES OF ENERGY. Butler, S. T. (Sydney Univ. (Australia)). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

From national symposium on energy and how we live; Adelaide, Australia (16 May 1973).

The roles of sources of nuclear energy are examined against the background of escalating world needs and diminishing world resources. The power from conventional fission reactors is destined to make a major contribution to world needs for up to twenty years, by which time the fuel from these reactors will be approaching exhaustion. Australia's role will be significant during this period. The possibility of the use of fast breeder reactors is discussed, as the way of increasing the energy availability from fissionable fuel by two orders of magnitude. Thermonuclear power is seen as the eventual stable world supplier of energy from nuclear sources. (auth)

29272 NUCLEAR ENERGY AND THE PRODUCTION OF ELECTRICITY IN THE LAST QUARTER OF THE CENTURY. Dejou, A. (Electricite de France, Paris). Energ. Nucl. (Paris); 15: No. 2, 99-102(Mar 1973). (In French).

The use of nuclear fission energy is the only solution capable of meeting the electrical energy demands of the last quarter of this century. The few remaining problems in this domain are enumerated: financing of nuclear programs, the ensuring of the supply of necessary materials (principally enriched fuel); the environment and public reaction; the cost and reliability, the choice of the type of reactor employed depends upon these factors. (FR)

29273 WHICH DESIGN FOR THIRD GENERATION NUCLEAR REACTORS. Valery, N. Elec. Eng. (Sydney); 50: No. 2, 20-22 (Feb 1973).

A brief description is given of the SGHWR reactor, the Dragon HTR and the AGR reactors. It is considered that one of these will provide an interim solution for electric power generation and will subsequently complement the fast breeder reactors. (AT)

29274 NUCLEAR POWER PARADOX IN THE UK. Nicholson, R. L. R. (United Kingdom Atomic Energy Authority, London). Energy Policy; 1: No. 1, 38-46(Jun 1973).

It is stated that, although since 1956 the UK has generated more electricity from nuclear power than any other country, the ordering rate of new nuclear power stations in the UK has been overtaken by the rate in the USA, West Germany, Japan, France, and Spain. The relation between the useful energy consumed per capita and GNP per capita in these countries is examined. In the UK, the contribution to total useful energy consumption by different fuels is shown, and the comparative performance of nuclear and conventional power stations. Future world demand for nuclear power is considered in the light of the estimated availability and cost of fossil fuels. It is concluded that the position in the UK is not significantly different from that in other countries, and that a big increase in the demand for nuclear power in this country is likely some time later in this decade or early in the 1980s. Problems of technology and investment, and environmental considerations, are reviewed briefly. (UK)

Reactor Fuel Cycle Economics

Refer also to abstract 29186.

Reactor Licensing and Regulation

Refer also to abstract 29440.

29275 (DOCKET-50003-189) INDIAN POINT STATION, UNIT 1. Semiannual Operating Report No. 21, October 1, 1972–June 30, 1973. (Consolidated Edison Co. of New York, Inc., New York). 29 Aug 1973. 120p. Dep. NTIS $8.00.

Information is presented concerning operations, periodic surveillance tests, power generation, shutdowns, maintenance, liquid and airborne radioactive releases, radiochemistry, and environmental monitoring. (FS)

29276 (DOCKET-50003-194) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence No. AO-3-1-3, Annual Surveillance Testing Showed That Battery Bank No. 1 Did Not Perform Satisfactorily. (Consolidated Edison Co. of New York, Inc., New York). 9 Jul 1973. 2p. Dep. NTIS $3.00.

29277 (DOCKET-50003-196) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence No. AO-3-1-4: Tube Leaks were Discovered While Raising Pressure on Unit 1 House Service Boiler No. 11. (Consolidated Edison Co. of New York, Inc., New York). 13 Jul 1973. 2p. Dep. NTIS $3.00.

29278 (DOCKET-50010-182) DRESDEN NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence: Scram Setpoint Drift on Channel 5. (Commonwealth Edison Co., Chicago, Ill.). 20 Aug 1973. 2p. Dep. NTIS $3.00.

29279 (DOCKET-50029-264) YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. 73-7: Discovery of a Protective System Set Point Exceeding the Specified Value. (Yankee Atomic Electric Co., Rowe, Mass.). 21 Aug 1973. 1p. Dep. NTIS $3.00.

29280 (DOCKET-50133-125) HUMBOLDT BAY POWER PLANT, UNIT 3. Semiannual Operating Report, January 1–June 30, 1973. (Pacific Gas and Electric Co., San Francisco, Calif.). 29 Aug 1973. 68p. Dep. NTIS $5.50.

Data concerning reactor operation; performance characteristics; results of surveillance tests and inspections; brief summaries of changes, tests, and experiments requiring AEC authorization; power generation; plant maintenance; radioactive effluent releases; environmental monitoring; and design changes are presented. (FS)

29281 (DOCKET-50155-161) BIG ROCK POINT NUCLEAR PLANT. Semiannual Operating Report No. 18, January 1–June 30, 1973. (Consumers Power Co., Jackson, Mich.). 31 Aug 1973. 69p. Dep. NTIS $5.50.

The plant was base loaded at several power levels during this period. The off-gas release rate of January 1 was about 15,000 μCi/s. Changes were made in the design of the containment sphere exhaust continuous air monitor, the fuel storage area, and in the containment clean and dirty sump piping. A number of procedure changes were required to improve safety. Listings are provided for maintenance procedures and safety tests. (FS)

29282 (DOCKET-50213-213) HADDAM NECK PLANT, UNIT 1. Semiannual Operating Report No. 73-1, January 1–July 1, 1973. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 28 Aug 1973. 22p. Dep. NTIS $3.25.

The plant was operated base-loaded through the period with load reduction to ~400 MW(e) for routine turbine stop and control valve testing about once a week. The plant was shut down three times for problems with a feedwater control valve, moisture separator reheater, and the turbine. Changes were made in the radioactive waste system to meet new guides. Routine radiochemical analysis of the coolant confirmed the integrity of the fuel cladding. A primary to secondary steam generator tube leak developed but was plugged during the June outage. The checks, calibrations, tests, inspections, and surveillance identified problems with the pressurizer high level trip channels, pressurizer pressure/core cooling trip unit set points, and an oscillating diesel load in the emergency diesel generator. Technical specification changes were made for reporting requirements, and the respiratory protection program. One key personnel change was made. (FS)

29283 (DOCKET-50213-224) HADDAM NECK PLANT, UNIT 1. Abnormal Occurrence No. 73-7: Unplanned Release of Radioactive Materials Due to Valve Gasket Leakage. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 3 Jul 1973. 3p. Dep. NTIS $3.00.

29284 (DOCKET-50213-225) HADDAM NECK PLANT, UNIT 1. Abnormal Occurrence No. 73-6: Leaking Valve in the Purification Line Between the Ion Exchange Outlet and the Reac-

tor Coolant Filter Inlet. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 3 Jul 1973. 3p. Dep. NTIS $3.00.

29285 (DOCKET-50213-228) HADDAM NECK PLANT, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Oct 1973. 332p. Dep. NTIS $18.75.

The environmental effects of construction and operation of the Connecticut Yankee Reactor are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

29286 (DOCKET-50219-279) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report No. 8, January 1–June 30, 1973. (Jersey Central Power and Light Co., Morristown, N. J.). 31 August 1973. 74p. Dep. NTIS $5.75.

The plant had an overall availability factor of 63.67%. There were six shutdowns initiated by unplanned automatic scrams. After the April 13 scram a partial turbine inspection and reactor refueling inspection were made. The recommended power level changes were found to be of limited value and a significant amount of generation was lost. Desirable margins from minimum critical heat flux ratio and peaking factor limits were maintained. An inoperable control rod forced an alteration in the rod withdrawal sequence and caused a load reduction. The rod worth minimizer was used for all reactor start-ups. Operating statistics, chronology of significant events, a maintenance summary, radiation waste summary, environmental monitoring, chemistry summary, facility changes concerning baffles, electromagnetic relief valves off-gas system, refueling bridge, core loading pattern, and drywell sump level sensors are reported. Procedure changes, testing, and core spray piping inspections are presented. (FS)

29287 (DOCKET-50219-287) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Correspondence Reporting a Failure of Diesel Generator 1-1 to Assume Load During a Surveillance Test. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Jun 1973. 2p. Dep. NTIS $3.00.

29288 (DOCKET-50219-302) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Malfunction of a Feedwater Check Valve Hinge Pin Seal Plug Resulting in Leakage to Both the Drywell Floor and the Torus. (Jersey Central Power and Light Co., Morristown, N. J.). 31 Jul 1973. 4p. Dep. NTIS $3.00.

29289 (DOCKET-50220-153) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report: Failure of Stack Gas Monitors. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 7 Sep 1973. 2p. Dep. NTIS $3.00.

29290 (DOCKET-50237-359) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence: Containment Cooling Service Water Valve 2-1501-3A Failed to Open. (Commonwealth Edison Co., Chicago, Ill.). 22 Aug 1973. 3p. Dep. NTIS $3.00.

29291 (DOCKET-50244-180) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report No. 7, January 1–June 30, 1973. (Rochester Gas and Electric Corp., N. Y.). 31 Aug 1973. 38p. Dep. NTIS $4.00.

Information is presented concerning operations, power generation, shutdowns, maintenance, changes, tests, experiments, radioactive effluent releases, environmental monitoring, and occupational personnel radiation exposures. (FS)

29292 (DOCKET-50251-153) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence No. 4-73-9: Accumulator Level Limiting Conditions for Operation Exceeded. (Florida Power and Light Co.). 20 Jul 1973. 3p. Dep. NTIS $3.00.

29293 (DOCKET-50255-175) PALISADES NUCLEAR PLANT. Abnormal Occurrence Report: Failure of Nuclear Instrumentation Start-Up Channels. (Consumers Power Co., Jackson, Mich.). 21 Aug 1973. 1p. Dep. NTIS $3.00.

29294 (DOCKET-50259-102) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Reactor Containment Building Integrated Leak Rate Test Report. (Tennessee Valley Authority, Chattanooga). 13 Aug 1973. 423p. (Docket-50260-93; Docket-50296-88). Dep. NTIS $23.25.

The integrated leak rate test was started on April 27, 1973, and completed on May 2, 1973. The test measured the leakage rates at 25 and 49 psig. Leakage rates using the absolute method were found to be 249 SCFH at 25 psig and 319 SCFH at 49 psig. An analysis of the test data which was made in accordance with ANSI-N45.4 shows that the measured leakage is well within the limits specified in technical specifications. Prior to conducting this test, a series of leak tests were performed to verify the integrity of the reactor pressure vessel and the drywell. These tests were performed on the reactor pressure vessel isolation valves, electrical penetrations, personnel air lock, and equipment hatches. (auth)

29295 (DOCKET-50259-110) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Safety Evaluation Report, Supplement No. 4. (Tennessee Valley Authority, Chattanooga). 10 Sep 1973. 12p. (DOCKET-50260-96; DOCKET-50296-91). Dep. NTIS $3.00.

The results of an evaluation of design modifications to resolve the emergency electrical power system deficiencies related to multi-unit operation are presented. An updated evaluation of the proposed design measures to protect against missiles resulting from overspeed of the recirculation pumps is provided. (FS)

29296 (DOCKET-50259-111) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. BFAO-737W: Failure of Core Spray System-Loop 1. (Tennessee Valley Authority, Chattanooga). 12 Sep 1973. 2p. Dep. NTIS $3.00.

29297 (DOCKET-50259-112) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. BFAO-738W: Malfunction of Steam Supply Valve to High-Pressure Coolant Injection Turbine. (Tennessee Valley Authority, Chattanooga). 12 Sep 1973. 2p. Dep. NTIS $3.00.

29298 (DOCKET-50259-116) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Interim Report on Failure of Governor on Emergency Diesel-Generator B Model 990-20-645E4. (Tennessee Valley Authority, Chattanooga). 12 Jul 1973. 3p. Dep. NTIS $3.00.

29299 (DOCKET-50259-117) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report Nos. BF EAO-732W, -733W, -734W, and -735W: Analysis of the Number of Shad Minnows and Other Fish Killed when Impinged on Intake Screens. (Tennessee Valley Authority, Chattanooga). 17 Aug 1973. 3p. Dep. NTIS $3.00.

29300 (DOCKET-50259-126) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Failure of Limitorque Mounting Bolts on Operators for RHR Valves 1-74-72 and 1-74-58. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 4p. Dep. NTIS $3.00.

29301 (DOCKET-50261-205) H. B. ROBINSON, UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 18 Jun 1973. 2p. Dep. NTIS $3.00.

29302 (DOCKET-50261-206) H. B. ROBINSON, UNIT 2. Abnormal Occurrences on Limiting Safety System Setpoints. (Carolina Power and Light Co., Raleigh, N. C.). 22 Jun 1973. 2p. Dep. NTIS $3.00.

29303 (DOCKET-50261-214) H. B. ROBINSON, UNIT 2. Abnormal Occurrence Report: Liquid Waste Release Without Representative Sample. (Carolina Power and Light Co., Raleigh, N. C.). 29 Aug 1973. 2p. Dep. NTIS $3.00.

29304 (DOCKET-50261-226) H. B. ROBINSON, UNIT 2. Abnormal Occurrence Report: Failure of Safeguards Equipment to Start on Manual Initiation. (Carolina Power and Light Co., Raleigh, N. C.). 17 Jul 1973. 3p. Dep. NTIS $3.00.

29305 (DOCKET-50263-225) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Operating Report No. 5, January 1–June 30, 1973. (Northern States Power Co., Minneapolis, Minn.). 30 Aug 1973. 161p. Dep. NTIS $10.25.

The operations summary including chronological history, plant design changes, performance characteristics, procedure changes, surveillance tests, inspections, changes in personnel, and radiation exposures is reported. Power operation and shutdowns, maintenance, radioactive effluent releases, and environmental monitoring are also presented. (FS)

29306 (DOCKET-50263-230) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Failure of Main Steam Line Drain Valve, MO-2374, to Close. (Northern States Power Co., Minneapolis, Minn.). 17 Aug 1973. 2p. Dep. NTIS $3.00.

29307 (DOCKET-50263-233) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Report on Main Steam Isolation Valve Leakage and Closure Time. (Northern States Power Co., Minneapolis, Minn.). 28 Jun 1973. 5p. Dep. NTIS $3.00.

29308 (DOCKET-50263-249) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Slow Closure of a Main Steam Isolation Valve MSIV 2-80A. (Northern States Power Co., Minneapolis, Minn.). 10 Aug 1973. 2p. Dep. NTIS $3.00.

29309 (DOCKET-50265-219) QUAD-CITIES STATION, UNIT 2. Unusual Event Concerning the Reactor Protection System Wiring and Corrective Action. (Commonwealth Edison Co., Cordova, Ill.). 28 Aug 1973. 2p. Dep. NTIS $3.00.

29310 (DOCKET-50266-120) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Abnormal Occurrence Report: Unscheduled Release of Radioactivity and Violation of a Limiting Condition for Operation. (Wisconsin Electric Power Co., Milwaukee). 16 Jul 1973. 4p. (Docket-50301-104). Dep. NTIS $3.00.

29311 (DOCKET-50266-121) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Failure of Circuit Breaker Overcurrent Trip Delay Device. (Wisconsin Electric Power Co., Milwaukee). 9 Aug 1973. 2p. (DOCKET 50301-105). Dep. NTIS $3.00.

29312 (DOCKET-50269-133) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report on Boron Analyses During Zero Power Physics Tests. (Duke Power Co., Charlotte, N. C.). 17 Jul 1973. 3p. Dep. NTIS $3.00.

29313 (DOCKET-50269-137) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report No. UE-269/73-6: Improper Review of Station Modification. (Duke Power Co., Charlotte, N. C.). 30 Jul 1973. 3p. Dep. NTIS $3.00.

29314 (DOCKET-50271-201) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-27, Detonation in Off-gas System Caused Back Pressure to Fracture Air Ejector Rupture Disc. (Vermont Yankee Nuclear Power Corp., Rutland). 17 Sep 1973. 3p. Dep. NTIS $3.00.

29315 (DOCKET-50271-202) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-19, RCIC Steam Isolation Valve 15 Failed to Close. (Vermont Yankee Nuclear Power Corp., Rutland). 3 Jul 1973. 3p. Dep. NTIS $3.00.

29316 (DOCKET-50271-203) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence No. AO-73-21, Malfunction of Microswitch. (Vermont Yankee Nuclear Power Corp., Rutland). 19 Jul 1973. 2p. Dep. NTIS $3.00.

29317 (DOCKET-50271-206) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report AO-73-20: Failure to Close of Drywell Purging and Vent Exhaust Valve V16-19-7A. (Vermont Yankee Nuclear Power Corp., Rutland). 6 Jul 1973. 1p. Dep. NTIS $3.00.

29318 (DOCKET-50275-52) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 1. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 914p. (Docket-50323-49). Dep. NTIS $47.75.

The general description of the plant; site characteristics including geography, demography, meteorology, hydrology, geology, seismology and nearby facilities; and the design criteria for structures, components, equipment, and systems are presented. (FS)

29319 (DOCKET-50275-53) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 2. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 605p. (Docket-50323-50). Dep. NTIS $32.25.

Design criteria for structures, components, equipment, and systems are presented including conformance with AEC criteria; classification of structures, components, and systems; wind criteria and tornado design; water level (flood) design criteria; missile protection; protection against dynamic effects associated with a LOCA; seismic design; design of Category 1 and 2 structures; mechanical systems and components; seismic design of Category 1 instrumentation and electrical equipment; and environmental design of mechanical and electrical equipment. The mechanical, nuclear, thermal, and hydraulic design of the reactor is described. (FS)

29320 (DOCKET-50275-54) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 3. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 522p. (Docket-50323-51). Dep. NTIS $28.75.

The integrity of the reactor cooling system, thermal hydraulic systems design, reactor vessel and appurtenances, component and subsystem design, instrumentation application, the thermal hydraulic design of the reactor, and the introduction to instrumentation and control are presented. (FS)

29321 (DOCKET-50275-55) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 4. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 295p. (Docket-50323-52). Dep. NTIS $16.75.

Instrumentation and controls for the reactor trip system, engineered safety features actuation system, systems required for safe shutdown, safety related display equipment, all other systems required for safety, and the plant control systems are described. (FS)

29322 (DOCKET-50275-56) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 5. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 444p. (Docket-50323-53). Dep. NTIS $24.25.

Information is presented concerning onsite, offsite, and dc power systems and auxiliary systems including fuel storage and handling, water systems, process auxiliaries, air conditioning, heating, cooling, and ventilation. The steam and power conversion system, including the turbogenerator, main steam lines, and the main condenser, is described. (FS)

29323 (DOCKET-50275-57) DIABLO CANYON NUCLEAR POWER PLANT: UNITS 1 AND 2. Operating License Application, FSAR, Volume 6. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 482p. (Docket-50323-54). Dep. NTIS $26.25.

The management of liquid, gaseous, and solid radioactive wastes is described. The offsite, process, and effluent radiological monitoring programs are explained. Radiation protection including ventilation, shielding, and the health physics program is discussed. Information concerning the applicant's organizational structure, training program, emergency planning, review and audit, plant procedures, plant records, industrial security, the test program, and the augmentation of the staff for initial tests and operations is presented. (FS)

29324 (DOCKET-50275-58) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 7. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 525p. (Docket-50323-55). Dep. NTIS $28.25.

Possible events which could cause accidents in the plant are identified. An assessment of the consequences of the possible plant accidents is provided and the potential consequences of these occurrences are demonstrated to be within the limits, guidelines, and regulations established by the AEC. (FS)

29325 (DOCKET-50275-59) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Operating License Application, FSAR, Volume 8. (Pacific Gas and Electric Co., San Francisco, Calif.). 1973. 321p. (Docket-50323-56). Dep. NTIS $13.25.

Technical specifications concerning safety limits, limiting safety system settings, conditions for operation, surveillance requirements, design features, and administrative controls are presented. The quality assurance program, which assures the adequacy of plant design and construction, is described. (FS)

29326 (DOCKET-50277-118) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Significant Deficiency Interim Report No. 5, High Pressure Service Water Valve Weld Failure. (Philadelphia Electric Co., Pa). 11 Jul 1973. 3p. (Docket-50278-95). Dep. NTIS $3.00.

29327 (DOCKET-50280-156) SURRY POWER STATION, UNIT 1. RO Inquiry Report No. 72-5Q, Safety Injection Pump Bearing Failure, November 12, 1972. (Virginia Electric and Power Co., Richmond). 22 Jun 1973. 5p. Dep. NTIS $3.00.

29328 (DOCKET-50280-158) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-72-08: Errata for Page 3, Paragraph 3. (Virginia Electric and Power Co., Richmond). 3 Jul 1973. 2p. Dep. NTIS $3.00.

29329 (DOCKET-50280-160) SURRY POWER STATION, UNITS 1 AND 2. Semiannual Operating Report, SOR-2, for the Period January 1, 1973–June 30, 1973. (Virginia Electric and Power Co., Richmond). 14 Sep 1973. 724p. (Docket-50281-128). Dep. NTIS $38.25.

Information is presented concerning nonradiological monitoring, radiological environmental monitoring, radioactive effluent releases, fuel shipments, occurrences in which temperature limitations on condenser cooling water discharge were exceeded, changes in station organization, operating summaries for each unit which include power generation, outages, facility design changes, performance characteristics, changes in procedures, maintenance, results of surveillance tests, containment leakage tests, changes, tests, and experiments requiring and not requiring AEC authorization. (FS)

29330 (DOCKET-50280-164) SURRY POWER STATION, UNIT 1. RO Inquiry Report No. 73-6Q, Disc Shaft Found Cracked in Main

Steam Trip Valves, April 3, 1973. (Virginia Electric and Power Co., Richmond). 28 Jun 1973. 5p. Dep. NTIS $3.00.

29331 (DOCKET-50282-152) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Malfunction of Safeguard Relay Racks During Testing. (Northern States Power Co., Minneapolis, Minn.). 27 Jul 1973. 2p. (DOCKET-50306-131). Dep. NTIS $3.00.

29332 (DOCKET-50285-105) FORT CALHOUN STATION, UNIT 1. Reactor Containment Building Leak Rate Test. (Omaha Public Power District, Nebr.). Jun 1973. 16p. Dep. NTIS $3.00.
The results for testing of the outer containment air lock door and all the containment penetrations that were capped off during the previous integrated leak test are presented. (JWR)

29333 (DOCKET-50285-107) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report, Failure of Emergency Diesels to Start During Routine Surveillance Testing. (Omaha Public Power District, Nebr.). 18 Jul 1973. 4p. Dep. NTIS $3.00.

29334 (DOCKET-50285-109) FORT CALHOUN STATION, UNIT 1. Unusual Event No. 73-1: Effects of Certain Pump Combinations on Pressurizer Spray Flow. (Omaha Public Power District, Nebr.). 7 Sep 1973. 2p. Dep. NTIS $3.00.

29335 (DOCKET-50285-125) FORT CALHOUN STATION, UNIT 1. Examination of the History of Reactor Coolant Pump "D" to Determine Flow Variation. (Omaha Public Power District, Nebr.). 9 Aug 1973. Dep. NTIS $3.00.

29336 (DOCKET-50289-112) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Failure of Nuclear Service River Water Pump 1C Motor. (Metropolitan Edison Co., Reading, Pa.). 20 Aug 1973. 3p. Dep. NTIS $3.00.

29337 (DOCKET-50289-120) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Apparent Breakdown of Quality Control Coverage During Inspection and Test of Protective Relay Systems and Associated Circuits. (Metropolitan Edison Co., Reading, Pa.). 6 Aug 1973. 3p. Dep. NTIS $3.00.

29338 (DOCKET-50293-151) PILGRIM NUCLEAR POWER STATION, UNIT 1. Facility Operating License, DPR-35, Amendment 1, Semiannual Operating and Maintenance Report No. 2, January 1, 1973 to June 30, 1973. (Boston Edison Co., Mass.). 29 Aug 1973. 49p. Dep. NTIS $4.25.
Information concerning operations, maintenance, radioactive effluents, and environmental monitoring are presented. Attachments are included which present summaries of recorded whole-body exposures and radioactive materials released to unrestricted areas, and a report concerning a residual chlorine analysis study. (FS)

29339 (DOCKET-50293-152) PILGRIM NUCLEAR POWER STATION, UNIT 1. License DPR-35, Amendment No. 1; Interference Between Control Rod 34-15 and an Adjacent Fuel Channel. (Boston Edison Co., Mass.). 22 Jun 1973. 4p. Dep. NTIS $3.00.

29340 (DOCKET-50293-157) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence No. AO-73-21, Actuation of Barksdale Pressure Switches. (Boston Edison Co., Mass.). 12 Jul 1973. 1p. Dep. NTIS $3.00.

29341 (DOCKET-50293-160) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence UO-73-11: Maintenance Problem Associated with "D" Salt Service Water Pump. (Boston Edison Co., Mass.). 31 Aug 1973. 2p. Dep. NTIS $3.00.

29342 (DOCKET-50293-173) PILGRIM NUCLEAR POWER STATION, UNIT 1. Data on Transient Analysis. (Boston Edison Co., Mass.). 2 Aug 1973. 8p. Dep. NTIS $3.00.

29343 (DOCKET-50295-150) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence Report: Diesel Generator 0 Trip During Safeguards Actuation Test. (Commonwealth Edison Co., Zion, Ill. (USA)). 24 Aug 1973. 3p. Dep. NTIS $3.00.

29344 (DOCKET-50295-162) ZION NUCLEAR PLANT, UNITS 1 AND 2. Abnormal Occurrence: Due to Operator Error, High Level on a Steam Generator Caused a Turbine Trip and Resulting Reactor Trip. (Commonwealth Edison Co., Zion, Ill. (USA)). 10 Aug 1973. 3p. (DOCKET-50304-114). Dep. NTIS $3.00.

29345 (DOCKET-50305-91) KEWAUNEE NUCLEAR POWER PLANT, UNIT 1. Pipe Rupture Analyses of Main Steam Piping Outside Containment. (Wisconsin Public Service Corp., Green Bay). 28 Aug 1973. 122p. Dep. NTIS $8.25.

29346 (DOCKET-50309-126) MAINE YANKEE ATOMIC POWER STATION. Monthly Operating Report No. 5-73, May 1973. (Maine Yankee Atomic Power Co., Westboro, Mass.). 29 Jun 1973. 28p. Dep. NTIS $3.50.

29347 (DOCKET-50309-135) MAINE YANKEE ATOMIC POWER STATION. Review of Liquid Tanks Which Contain Radioactivity That Overflow to Other Than a Controlled Water Pathway to the Environs. (Maine Yankee Atomic Power Co., Westboro, Mass.). 1 Aug 1973. 2p. Dep. NTIS $3.00.

29348 (DOCKET-50317-118) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Deficiency in Flow Rate in Flushing the High-Pressure Safety-Injection System. (Baltimore Gas and Electric Co., MD). 13 Aug 1973. 2p. (DOCKET-50318-106). Dep. NTIS $3.00.

29349 (DOCKET-50324-94) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Report on Resolution of the Reactor Pressure Vessel Jet Pump Adapter to Shroud Support Plate Weld. (Carolina Power and Light Co., Raleigh, N. C.). 10 Jul 1973. 12p. (DOCKET-50325-94). Dep. NTIS $3.00.

29350 (DOCKET-50331-110) DUANE ARNOLD ENERGY CENTER. Reports on Failure of dc Motor Starters and ac Reversing Motor Starters. (Iowa Electric Light and Power Co., Cedar Rapids). 3 Jul 1973. 5p. Dep. NTIS $3.00.

29351 (DOCKET-50334-84) BEAVER VALLEY POWER STATION, UNIT 1. License Application, FSAR, Amendment 4. (Duquesne Light Co., Pittsburgh, Pa). 4 Sep 1973. 615p. Dep. NTIS $32.75.

29352 (DOCKET-50354-47) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Safety Evaluation by Directorate of Licensing, Supplement 2. (Public Service Electric and Gas Co., Newark, N. J.). 30 Aug 1973. 25p. (Docket-50355-47). Dep. NTIS $3.25.

29353 (DOCKET-50390-39) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Evaluation of Sonic Velocities in Lower Compartment. (Tennessee Valley Authority, Chattanooga). 5 Sep 1973. 15p. (Docket-50391-39). Dep. NTIS $3.00.
The location and time duration for which sonic flow exists and the acceptability of sonic flow are explained. Flow choking does not represent a threshold beyond which sharper increases in compartment pressure can be expected. (FS)

29354 (DOCKET-50412-30) BEAVER VALLEY POWER STATION, UNIT 2. License Application, FSAR, Volume 1. (Duquesne Light Co., Pittsburgh, Pa). 10 Nov 1972. 425p. Dep. NTIS $23.25.
Information is presented concerning design highlights, plant description, single failure criteria, general design criteria, safety guides, comparison with other stations, and identification of contractors. The reactor site is described including the demography, meteorology, climatology, hydrology, geology, seismology, soil mechanics, and environmental radiological monitoring. Appendices included consist of the meteorological program's annual reports and geological considerations influencing the proposed site selection of Beaver Valley Station. (FS)

29355 (DOCKET-50412-31) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 2. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 291p. Dep. NTIS $16.75.
The nuclear, hydraulic, thermal and mechanical reactor design and design evaluation are presented. Appendices for the reactor site are included which concern a seismicity analysis, effect of soil conditions on seismic threat to the Beaver Valley Station, boring logs, and seismic velocity measurements. (FS)

29356 (DOCKET-50412-32) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 3. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 234p. Dep. NTIS $13.75.
Information is presented concerning the three similar heat transfer loops connected in parallel to the pressure vessel, the coolant pumps, steam generators and associated piping and valves, pressurizers, pressure relief tanks, and the instrumentation necessary for operational control. The containment system, which includes the containment isolation system and the internal containment system, is described. (FS)

29357 (DOCKET-50412-33) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 4. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 351p. Dep. NTIS $19.75.
The equipment design and fabrication criteria, ECCS, contain-

ment depressurization system, and the post DBA hydrogen control system of the engineered safety features are described. Instrumentation and control concerning the trip system, engineered safety features, systems for safe shutdown, safety related display systems, and unit control systems are presented. The design bases, interconnections, station service systems, emergency power, and tests and inspection of the electrical system are examined. (FS)

29358 (DOCKET-50412-34) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 5. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 239p. Dep. NTIS $14.00.

The auxiliary and emergency systems, which include the chemical and volume control, RHR, component cooling water, sampling, vent and drain, compressed air, fire prevention, water supply and treatment, fuel handling, ventilation, diesel fuel oil, neutron shield tank cooling systems, the fuel pool cooling and purification, and the decontamination facility and structure, are presented. The steam and power conversion system, which receives steam generated by the steam generators in the cooling system and produces electrical power and includes the main steam system and the turbogenerator, is described. (FS)

29359 (DOCKET-50412-35) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 6. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 311p. Dep. NTIS $17.75.

The radioactive waste systems, radiation protection, organization structure of the applicant, training, emergency planning, review and audit, procedures, plant records, industrial security, safety, the test program, and test program responsibilities and implementation are described. Appendices on the estimated quantities of radioactive liquid and gaseous wastes for the waste disposal system and for release to the environment and an evaluation of the doses from population radiation exposure due to normal operation of the Beaver Valley Station are presented. (FS)

29360 (DOCKET-50412-36) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 7. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 381p. Dep. NTIS $32.25.

Safety aspects are evaluated demonstrating that the station can be operated safely even if highly unlikely events are postulated. Information is presented concerning core and coolant boundary protection analysis, standby safety analysis, and loss of coolant accidents. (FS)

29361 (DOCKET-50412-37) BEAVER VALLEY POWER STATION, UNIT 2. License Application, PSAR, Volume 8. (Duquesne Light Co., Pittsburgh, PA). 10 Nov 1972. 533p. Dep. NTIS $28.75.

Information is presented concerning structure and machinery arrangement, structural design criteria, structural materials, construction practices and procedures, specific structural design, mechanical systems, components, component seismic design, criteria for protection against the dynamic effects associated with a LOCA, and the technical specifications. The following appendices to the safety analysis are included: effects of a high pressure turbine rotor fracture and low pressure turbine disc fracture at design overspeed, radiation sources, heat transfer coefficients used in LOCTA-R2 core thermal analysis, and normal operation and operational transients. (FS)

29362 (DOCKET-50434-13) SURRY POWER STATION, UNITS 3 AND 4. Applicant's Environmental Report, Construction Permit Stage, Volume 1. (Virginia Electric and Power Co., Richmond). Apr 1973. 656p. (Docket-50435-13). Dep. NTIS $35.00.

The environmental effects of construction and operation of the Surry Power Station, Units 3 and 4 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

29363 (DOCKET-50434-14) SURRY POWER STATION, UNITS 3 AND 4. Applicant's Environmental Report, Construction Permit Stage, Volume 2. (Virginia Electric and Power Co., Richmond). Apr 1973. 373p. (DOCKET-50435-14). Dep. NTIS $20.75.

29364 (DOCKET-50452-1) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. License Application. (Detroit Edison Co., Mich.). 4 Jun 1973. 83p. (DOCKET-50453-1). Dep. NTIS $6.25.

29365 (DOCKET-50452-2) GREENWOOD ENERGY CENTER, UNITS 2 AND 3. Antitrust Review Information, Exhibit E, Information Requested by the Attorney General for Facility License Application. (Detroit Edison Co., Mich.). 1973. 84p. (DOCKET-50453-2). Dep. NTIS $6.25.

29366 (DOCKET-50454-1) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application. (Commonwealth Edison Co., Chicago, Ill.). 16 Aug 1973. 78p. (DOCKET-50455-1; DOCKET-50456-1; DOCKET-50457-1). Dep. NTIS $6.00.

29367 (DOCKET-50454-2) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). Antitrust Review Information Requested by the Attorney General, Appendix L. (Commonwealth Edison Co., Chicago, IL). 16 Aug 1973. 76p. (DOCKET-50455-2, DOCKET-50456-2; DOCKET-50457-2). Dep. NTIS $6.00.

29368 (DOCKET-50454-3) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application, PSAR, Volume 1. (Commonwealth Edison Co., Chicago, IL). 16 Aug 1973. 891p. (DOCKET-50455-3; DOCKET-50456-3; DOCKET-50457-3). Dep. NTIS $46.75.

Two power plants to be built at different sites are described. The plants, which are as identical as the site characteristics permit, utilize RESAR-3 when possible. Each plant consists of two units having identical NSSS with PWR type reactors designed for a power output of 3625 MW(t). The equivalent gross and approximate net electrical outputs are 1175 MW(e) and 1120 MW(e). The reactor containments are of post-tensioned concrete with carbon steel liners. Byron Plant cooling is provided with two natural draft and one mechanical draft cooling towers. Braidwood cooling utilizes two man made lakes. The plant description, comparison tables, agents and contractors, requirements for further information, and the application of the AEC regulatory guides for both plants are presented. The geography, demography, meteorology, seismology, hydrology, and nearby military, industrial, and transportation facilities for the Byron Plant are given. (FS)

29369 (DOCKET-50454-4) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application, PSAR, Volume 2. (Commonwealth Edison Co., Chicago, Ill). 16 Aug 1973. 764p. (DOCKET-50455-4; DOCKET-50456-4; DOCKET-50457-4). Dep. NTIS $40.25.

The geography, demography, meteorology, hydrology, geology, and seismology as well as industrial, transportation, and military facilities near the Braidwood Station are described. (FS)

29370 (DOCKET-50454-5) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application, PSAR, Volume 3. (Commonwealth Edison Co., Chicago, Ill). 16 Aug 1973. 536p. (DOCKET-50455-5; DOCKET-50456-5; DOCKET-50457-5). Dep. NTIS $29.00.

The design criteria for structures, components, equipment, and systems are presented including conformance with AEC general design criteria; classification of structures, components, and systems; wind and tornado, water level (flood), and missile protection design criteria; seismic design; criteria for protection from loss-of-coolant; Category 1 and 2 structure designs; mechanical systems and components; seismic design of Category 1 instrumentation and electrical systems; and the environmental design of mechanical and electrical equipment. The mechanical, nuclear, thermal and hydraulic designs for the reactor are described. The reactor coolant system including the integrity of the reactor coolant steam boundary, the thermal and hydraulic design, reactor vessel and appurtances, component and subsystem design, and instrumentation application is described. The engineered safety system, which is explained, concerns features provided to mitigate the consequences of postulated accidents and includes the containment system, ECCS, auxiliary feedwater system, and habitability systems. An appendix on blowdown and core reflood analysis is presented. (FS)

29371 (DOCKET-50454-6) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application, PSAR, Volume 4. (Commonwealth Edison Co., Chicago, Ill.). 16 Aug 1973. 423p. (DOCKET-50455-6; DOCKET-50456-6; DOCKET-50457-6). Dep. NTIS. $23.25.

Information is presented concerning the reactor trip system, engineered safety features, systems required for safe shutdown, safety related display instrumentation, all other systems required for safety, control systems, onsite and offsite power systems, auxiliary systems, and the steam and power conversion systems. (FS)

29372 (DOCKET-50454-7) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2).

License Application, PSAR, Volume 5. (Commonwealth Edison Co., Chicago, Ill.). 16 Aug 1973. 380p. (DOCKET-50455-7; DOCKET-50456-7; DOCKET-50457-7). Dep. NTIS $21.00.

The liquid, gaseous, and solid wastes systems and the process, effluent, and offsite monitoring programs are explained. Radiation protection including shielding, ventilation and the radiation monitoring program is discussed. Conduct of operations including training, emergency planning, review and audit, plant procedures, plant records, and industrial security is examined, and information on initial tests and operation is presented. (FS)

29373 (DOCKET-50454-8) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2, AND BRAIDWOOD UNITS 1 AND 2). License Application, PSAR, Volume 6. (Commonwealth Edison Co., Chicago, Ill.) 16 Aug 1973. 356p. (Docket-50455-8; Docket-50456-8; Docket-50457-8). Dep. NTIS $20.00.

Accident analyses are presented including information on normal operation and operational transients, faults of moderate frequency, infrequent faults, limiting faults, and non-limiting hypothetical events. The Technical Specifications are provided and quality assurance during design, construction, and operation is explained. Appendices on dose models for evaluation of the environmental consequences of accidents, systems shared by the two units, computer programs used for structural analysis and design, and a turbine missile study are included. Quality assurance manuals for Commonwealth Edison and Sargent Lundy are presented. (FS)

29374 (DOCKET-50454-9) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2), BYRON STATION ENVIRONMENTAL REPORT, VOLUME 1. (Commonwealth Edison Co., Chicago, Ill). 13 Sep 1973. 889p. (DOCKET-50455-9). Dep. NTIS $46.50.

The environmental effects of construction and operation of the Byron Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

29375 (DOCKET-50454-10) BYRON/BRAIDWOOD STATIONS (BYRON UNITS 1 AND 2), BYRON STATION ENVIRONMENTAL REPORT, VOLUME 2. (Commonwealth Edison Co., Chicago, Ill). 16 Aug 1973. 590p. (DOCKET-50455-10). Dep. NTIS $31.50.

29376 (DOCKET-50456-9) BYRON/BRAIDWOOD STATIONS (BRAIDWOOD UNITS 1 AND 2), BRAIDWOOD STATION ENVIRONMENTAL REPORT, VOLUME 1. (Commonwealth Edison Co., Chicago, Ill). 16 Aug 1973. 684p. (DOCKET-50457-9). Dep. NTIS $36.25.

The environmental effects of construction and operation of the Braidwood Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

29377 (DOCKET-50456-10) BYRON/BRAIDWOOD STATIONS (BRAIDWOOD UNITS 1 AND 2) BRAIDWOOD STATION ENVIRONMENTAL REPORT, VOLUME 2. (Commonwealth Edison Co., Chicago, Ill). 16 Aug 1973. 689p. (DOCKET-50457-10). Dep. NTIS $36.50.

29378 (RDT-F-2-2(8-73)) QUALITY ASSURANCE PROGRAM REQUIREMENTS. (Division of Reactor Research and Development (AEC), Washington, D. C.). Aug 1973. 40p. RSO.

General requirements for planning, managing, conducting, and evaluating quality assurance programs for reactors and test facility projects and processes, structures, components, and systems are presented. Requirements are based on proven practices and provide means of control and verification whereby those responsible for project management can assure that the quality required for safe, reliable, and economic operation is achieved. (FS)

GENERAL

Civilian Defense

29379 (AD-762079) VULNERABILITY OF REGIONAL ELECTRIC POWER SYSTEMS TO NUCLEAR WEAPONS EFFECTS. Final Report. Lambert, B. K.; Minor, J. E. (Texas Tech Univ., Lubbock (USA)). May 1973. Contract DI-14-01-0001-1485. 109p. NTIS.

The development of a conceptual model for evaluating electric power systems, the formulation of a regional electric power system model, and the application of the model to a specific regional electric power system (Louisiana-Southern Mississippi) are made. The model presented is highly flexible and can be utilized for electric power systems of any magnitude from a local level to a national level. The general model concept employs the use of nodes, links, and an objective function that measures the response of a system to disruptions. Basically, the model is a constrained network flow model that is transformed to a modified transhipment linear programming format for analysis. (NTIS)

Energy Utilization and Economics

Refer also to abstracts 27336, 27706, 29064, and 29379.

29380 (AD-743494) ENGINEERING–ECONOMIC POTENTIAL FOR POWER PLANT WASTE HEAT UTILIZATION. Faucher, R. J.; Goodson, R. E. (Purdue Univ., Lafayette, Ind. (USA). Automatic Control Center). May 1972. Contract N00014-67-A-0226-0012. 37p. (ACC-72-6). NTIS.

The work was undertaken to formulate a quantitative mechanism that would facilitate evaluation of power plant waste heat utilization potential. Heat at usable temperatures is made available by extraction from the turbine. Incremental rates for reductions in electric output and heat rejection are obtained for various amounts and locations of waste heat extraction. The maximum justifiable investment (MJI), for a waste heat system, is calculated using a present worth criterion and at constant thermal input to the turbine cycle. A series of thermal market prices is applied in order to determine the sensitivity of the MJI to potential market values. Results for a typical medium-sized plant are summarized. (GRA)

29381 (CONF-730205-4) ELECTRIC ENERGY REQUIREMENTS FOR ENVIRONMENTAL PROTECTION. Hirst, E.; Healy, T. (Oak Ridge National Lab., Tenn.; Santa Clara Univ., Calif. (USA). Dept. of Electrical Engineering). 1973. 20p. Dep. NTIS $3.00.

From conference on energy, demand, conservation, and institutional problems; Cambridge, Massachusetts, USA (12 Feb 1973).

The amount of electricity needed for (or saved by) operation of several environmental quality strategies is examined. These strategies include: electric mass transit, waste water treatment, solid waste disposal, air pollution control, waste heat dissipation, and electricity conservation. Energy requirements of existing electric mass transit systems are compared with the new BART system, buses, and autos. Electric energy costs, as a function of plant size, are examined for primary/secondary sewage plants. Electricity costs and savings are computed for solid waste disposal, recycle, and use as fuel. Electricity needs for air pollution control at stationary sources and from motor vehicles are evaluated. Electricity needs for use of cooling towers at power plants are reviewed. Finally, potential energy savings which reduce air and thermal pollution levels are examined. The electricity required to meet the needs discussed here—based on the assumptions in this study—are small relative to total kilowatt-hour consumption. (auth)

29382 (CONF-730560-1) ALTERNATIVE ENERGY SOURCES: A RESEARCH CHALLENGE. George, D. W. (Sydney Univ. (Australia)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

From symposium on the energy crisis: implications for secondary industry; Sydney, Australia (23 May 1973).

Methods of obtaining energy such as controlled thermonuclear fusion, direct solar conversion, or deep geothermal resources of energy are considered alternative energy sources in a global sense. In Australia, nuclear fission and natural gas are considered alternative or unconventional energy sources. One significant area of alternative energy source discussed is the energy currently dissipated to the environment in a nonproductive manner through the limitations of conventional conversion technology and which in overall terms often exceeds that actually used by a factor of two or three. Research into improved methods of conversion includes areas such as MHD power generation and fuel cells. It also includes the concept of "total industrial energy." Other alternative energy sources discussed include the natural sources of primary energy, namely, solar energy, tidal energy, wind, and geothermal energy. (MCW)

29383 (NP-19835) FUELS FOR THE ELECTRIC UTILITY INDUSTRY, 1971–1985. (National Economic Research Associates, New York (USA)). 15 Aug 1972. 173p.

For Edison Electric Inst., New York.

An assessment, nationally and by regions, is made of the outlook for electricity demand, and of the price and availability of the fuels which will be required to generate that electricity in 1980 and 1985. Comparisons between fuel forms are made. (DLC)

29384 (NP-19854) DEVELOPMENT OF THE NUCLEAR–ELECTRIC ENERGY ECONOMY. Ross, P. N. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jun 1973. 18p.

A brief, graphical (34 figures) review is presented of energy sources of the world and USA. Oil and natural gas reserves are shown to be extremely limited, leaving coal as the basis for the petroleum and petrochemical industry. Patterns of energy use in the industrial and residential sectors are analyzed. It is proposed that the development of a nuclear–electric energy economy is the only viable long-term solution to the energy problem. The impact of this proposition on the electric power industry and on future needs for oil and gas is described. (DLC)

29385 (ORNL-NSF-EP-58) ENERGY COST OF GOODS AND SERVICES. Herendeen, R. A. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 122p. Dep. NTIS $8.25.

The 1963 Input-Output Table (U. S. Department of Commerce) was converted to energy terms. The results facilitate calculation of the total energy cost of many consumer goods and services. Total energy cost denotes all energy inputs in the manufacture/sales chain, including extraction of raw materials, primary processing, transportation, intermediate and final fabrication, and final marketing activities. A 362 sector breakdown has been used, and 5 energy sectors are included (coal, crude oil and gas extraction, refined petroleum, electricity, and gas sales). Results are in the form of coefficients which transform dollar expenditures in the 362 sectors into energy impact. The methodology of the conversion is described in detail; basically, it involves combining detailed energy pricing data with existing dollar sales data. Potential shortcomings are discussed; many are inherent to the input–output approach itself. It is hoped that the results will be useful in many applications. Four are presented here: a method to obtain a detailed breakdown of the energy to make a product; e.g., the energy needed to make the glass, steel, rubber, etc., contained in an automobile; a calculation of the total energy impact of the private auto in 1963, in which the many auto-associated expenditures are assigned an appropriate energy cost; a calculation of the energy-efficiency of the energy sectors in providing energy to final demand; and a calculation of the energy cost of a kitchen electric mixer. (auth)

29386 (UCRL-74807) SOME ELEMENTS OF THE NORTHERN GULF OF MEXICO BASIN GEOPRESSURE ENERGY RESOURCE. Myers, B.; Nelson, R.; Howard, J.; Austin, R. (California Univ., Livermore. Lawrence Livermore Lab). 7 Jun 1973. 27p. (CONF-730659-1). Dep. NTIS $3.50.

From geothermal hearings conference; Washington, District of Columbia, USA (14 Jun 1973).

It has been shown that there may be a very substantial energy resource in the Gulf of Mexico Basin in two forms, geopressured water and contained natural gas. Economic analyses show that the most conventional scheme, the 6⅝-inch well pipe-duplex conversion system, could give electric power costs in the range of two to four times present electric power costs to lower levels. The magnitude of the stored energy in these geopressure regions of Texas and Louisiana, the representative power cycles for conversion of this stored energy, and the economics of the situation are studied. (MCW)

29387 COAL: THE ONCE AND FUTURE KING. Fri, R. W. (Environmental Protection Agency, Washington, DC). Combustion; 5: No. 3, 8-10(Sep 1973).

The conflict between coal use and the Clean Air Act, the rising US energy demands, and the limited future supply of oil and gas as compared with coal reserves, and the need for the wisest possible use of US fossil fuel resources are discussed. (LCL)

29388 DEVELOPMENT TRENDS IN ENERGY CONSUMPTION AND ENERGY GENERATION IN THE CHEMICAL INDUSTRY. Wagner, H. Combustion; 5: No. 3, 18-24(Sep 1973).

The history of power plants built by German chemical companies to supply their energy needs in the 1920-to-1940 period is reviewed, and the role of the chemical industry in industrial energy consumption in West Germany as projected to 1980 is described. Data are presented on electric power consumption for the production of: chlorine, the largest consumer of electricity in the chemical industry; calcium carbide; phosphorus; synthetic gases; petroacetylene; silicon carbide, and ethylene. The trend in energy consumption in West German industry as a whole is compared with the chemical industry. Finally, the main factors that affect energy consumption and its structure are discussed. These include West German policies on environmental considerations, economic factors, tax laws, reliability of supplies, supply of natural resources, and nuclear power development. (LCL)

29389 DISTRIBUTION AUTOMATION: AN UPHILL FLIGHT FOR MOST, REALITY FOR FEW. Marks, J. A. (ed.) Elec. Light Power, T/D Ed.; 41-45(Apr 1973).

Distribution system automation beyond the substation is available in terms of technology. The principal roadblock is the high cost of communication channels and of pole-mounted monitoring and control modules. Even if some mutual, low-cost signalling channels could be arranged, the utilities would have to agree on codes, control and data points and functional size of a field control/monitoring module. Since separate utility design prerogatives are rarely given up in favor of a "standard", agreement on this point seems remote in the near (5-10 year) term. Meanwhile, computer control of substations is about as close as most utilities are likely to come to improved loading and multiple use of feeders that will also reduce outages. But even that degree of automation is remote without operating data to justify increased budgets. This means that both the operating and engineering divisions must agree on the objectives mentioned at the beginning of this report: low cost, good service, ease of operation and overall planning. (auth)

29390 FUEL SHORTAGE PLAGUES GAS TURBINES. Smock, R. W. (ed.) Elec. Light Power, E/G Ed.; 51: No. 15, 30-33(Aug 1973).

The prime fuels for gas turbines are natural gas and light distillate oils, both of which are becoming more scarce as the demand for power produced by gas turbines increases. Therefore, alternate fuels are being investigated and include crude oil, residual oil, kerosene, coal gas, and gasified residual oil. The advantages and disadvantages of each fuel are discussed. It is concluded that gas turbines face a fuel-short future unless heavy oil is used over the short term and coal over the long term. (LCL)

29391 LONG-TERM PLANNING: NEW RULES FOR A NEW BALLGAME. Scarola, J. A.; Ruotolo, D.; Sweenery, F. J. Jr. (Ebasco Services, Inc., New York). Elec. Light Power, E/G Ed.; 51: No. 15, 34-37(Aug 1973).

New requirements for the long-term planning to meet future power generation requirements are discussed. Factors which have become critically important include increased and increasing lead times, contingency planning for changes in conditions after a plan has been adopted, cash flow needs, and sharing of the planning responsibilities by utility owners, designers, builders, and suppliers. (LCL)

29392 WORLD ENERGY MODELLING: THE DEVELOPMENT OF WESTERN EUROPEAN OIL PRICES. Deam, R. J.; Laughton, M. A.; Hale, J. G.; Isaac, J. R.; Leather, J.; O'Carroll, F. M.; Ward, P. C. (Queen Mary Coll., London). Energy Policy; 1: No. 1, 21-34(Jun 1973).

A computer model is being constructed to cover the whole international energy industry. Results confirm that the concepts and assumptions being used in building the World Energy Model are applicable to the real world. The short-term behavior of oil product prices in Europe over the past six years has been consistent with the hypothesis of free competition acting on the kind of marginal cost structure assumed in the model. Long-term average relationships between oil product prices agree with the implications of a simplified version of the model's representation of refining economics. Work now in progress is steadily improving the breadth of coverage and degree of detail of the results that can be obtained. (DLC)

29393 US ENERGY POLICY AFTER THE PRESIDENT'S MESSAGE. Corrigan, R. (National Journal, Washington, DC). Energy Policy; 1: No. 1, 65-70(Jun 1973).

Some of the problems coming with increasing oil imports are described. The President's program is outlined (oil production, allocation, natural gas, coal, nuclear, energy research, energy conservation) and prospects are discussed. A brief account is given of political organization and attitudes in the White House. (DLC)

29394 PROSPECTS FOR SOLAR ENERGY. Energy Policy; 1: No. 1, 83-84(Jun 1973).

Three uses of solar energy were identified in the NSF-NASA panel report: heating/cooling of buildings, conversion of organic materials to fuels, and electric power generation. A breakdown of the 15-year R & D program covering all the Panel's recommendations is given. Possible ways of using solar energy are described briefly. (DLC)

29395 US CONSUMPTION OF ENERGY IN 1972: PRELIMINARY FIGURES. Energy Policy; 1: No. 1, 85-86(Jun 1973).

Total energy consumption in 1972 is estimated to be 72.091×10^{15} Btu, a 4.9% increase over 1971. The distribution among the various energy sources is tabulated for 1971 and 1972. Net imports of all fuels increased 24.5% over 1971; the net trade in fossil (mineral) fuels is also tabulated. Production of energy sources is discussed: fossils, nuclear, hydro. (DLC)

29396 POWER PLANT AUXILIARY EQUIPMENT: IT'S STILL JUST GROWING. Smock, R. (ed.) Elec. Light Power, E/G Ed.; 51: No. 15, 21-26(Aug 1973).

The development of auxiliary equipment, such as pumps, valves, fans, pulverizers, etc., for conventional and nuclear power plants is reviewed. It is concluded that, with the exception of power plant water treatment equipment, most of the current development is focussed on the production of large scale units which are more economical to produce and operate. (LCL)

29397 MERRIMEC STATION HELPS ST. LOUIS DISPOSE OF MUNICIPAL WASTE. Elec. Light Power, E/G Ed.; 51: No. 17, 42-44(Sep 1973).

St. Louis delivers prepared solid waste to Union Electric, which introduces the refuse into two tangentially fired boilers to provide ~10% of the total fuel requirement. About 300 tons of refuse are consumed per day. Flow diagrams are given of the refuse processing, receiving, and firing facilities. Other than a refuse-burning port in each corner of the furnace, no modifications were made to the boilers, and the refuse is burned in suspension along with the injected coal. The only operating problem was the nonferrous metals, which should be removed by an added air/gravity separating system. (DLC)

29398 CONALCO: AN INDUSTRIAL COMBINED-CYCLE INSTALLATION. Elec. Light Power, E/G Ed.; 51: No. 17, 50-51(Sep 1973).

A 87.5-MW combined-cycle plant was constructed at Consolidated Aluminum Co., Lake Charles, La., to power its 35,000-ton/year aluminum plant and 200,000-ton/year calcine coke plant. The power plant includes three gas turbines and three boilers. Operation experience is described briefly. (DLC)

29399 KEOWEE-TOXAWAY: INTEGRATED CAPACITY ADDITIONS ON A GRAND SCALE. Elec. Light Power, E/G Ed.; 51: No. 17, 40-41(Sep 1973).

Duke Power's Keowee-Toxaway project calls for 2500 MW of combined nuclear, hydro, and pump-storage capacity which will be further expanded by additional fossil-fired stations and other pump storage facilities. The Oconee nuclear station is the base-load thermal capacity, the Lake Jocassee dam is the medium-capacity-factor pump-storage plant, and the Lake Keowee dam along with some of Jocassee's capacity represents the peaking hydro capacity. Fixed and variable unit costs are summarized, and costs of Keowee-Toxaway are compared to closed-cycle pumped-storage and coal-fired steam alternatives. (DLC)

29400 LUDINGTON PUMPED STORAGE FACILITY: LARGEST OF ITS TYPE. Elec. Light Power, E/G Ed.; 51: No. 17, 38-39(Sep 1973).

This facility, built for Consumers Power Co. and Detroit Edison, generates 1,872 MW(e) on the shore of Lake Michigan. A description is given of the reservoir intakes, structure, pump-turbines and generator-motors. (DLC)

29401 NECESSARY PROGRESS IN COMMUNITY ENERGY POLICY. Bull. Eur. Communities, Suppl.; 1-27(Nov 1972).

Since 1969, the context of the energy policy has been changed. The "First Guidelines for a Community Energy Policy" issued in Dec. 1968 is updated and amplified. Besides the general proposals, proposals are also made by the Commission for the individual sectors: oil, natural gas, coal, electricity, and nuclear energy. (DLC)

29402 DEEPWATER PORTS: ISSUE MIXES SUPERTANKERS, LAND POLICY. Science; 181: No. 4102, 825-827(31 Aug 1973).

The USA will be relying heavily on foreign oil at least through the 1980's, even if a policy of energy conservation is adopted such as discouraging the use of heavy, high-gas consumption automobiles. The cost of providing existing ports with facilities to accommodate the supertankers is examined. Since this appears to be prohibitive, both economically and environmentally, the deepwater terminals are discussed. There are varying concepts of deepwater terminals, ranging from the building of an artificial island and breakwater to the simple concept of the single point mooring (SPM). A deepwater terminal of the SPM type can offer environmental as well as economic advantages over alternative systems for the delivery of imported oil. The problems peculiar to the supertanker and the "landside" problems associated with large-scale delivery of oil by supertankers and offshore terminals are indicated. (MCW)

29403 ENERGY OPTIONS FOR THE UNITED STATES. Felix, F. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 9, 63-68 (Sep 1973).

The production, transportation, and utilization of energy has come to be associated with undesirable consequences such as pollution, degradation of the environment, and balance-of-trade deficit, and provisions for jobs, creature comforts, and a high standard of living have been forgotten. By sketching out an "anatomy of energy" the author hopes to steer public sentiment towards a more constructive perspective concerning the energy options available in the USA. The estimates and projections are checked with data from the Department of the Interior. The share of energy consumed and the exponential growth rate in the USA are discussed. Nuclear power and the new energy sources and systems are evaluated. Near-term energy needs may be helped by conservation and increased efficiency practices. The interrelationships of energy, geopolitics, international trade, economics, and national security are discussed. (MCW)

29404 MANUFACTURE OF LOW-SULFUR BOILER FUELS FROM S-CONTAINING PETROLEUM BY THERMAL CRACKING OF TAR AND HYDROCLEANING OF HEAVY DISTILLATES. Teregulov, D. Kh.; Feigin, S. A.; Kostyukovskaya, M. B.; Korshunova, L. N.; Kulikova, G. P. Khim. Tekhnol.; No. 5, 36-39 (1972). (In Russian).

The scheme of the industrial-scale process is presented for treating the residues from high-sulfur crudes to give an ash-free liquid fuel with a sulfur content of 1.5 to 0.5%. Vacuum gas oil from the direct distillation of petroleum and tar is used as the raw material. An economic evaluation of the process indicates that decreasing the S content from 1.5% to 0.5% increases the capital expenditure 16% and the operating cost 38% for one of the Russian petroleums studied. To achieve the 0.5% S, the tar must be thermo-cracked and the residue boiling above 500°C completely recycled. More of the light fraction and less liquid fuel is formed in this case. The uses of the products obtained at various distillation stages (e.g., aviation fuel by hydropurification of the 120 to 180°C fraction) are mentioned. (TTT)

29405 DRY GEOTHERMAL WELLS: PROMISING EXPERIMENTAL RESULTS. Hammond, A. L. (Dept. of Interior, Washington, DC). Science; 182: No. 4107, 43-44 (5 Oct 1973).

Experimental results are described for a test well drilled 780 m into granite rock at one edge of a huge volcanic caldera in the Jemez Mountains of northern New Mexico by researchers from LASL, an Atomic Energy Commission facility. Water was pumped under pressure into a section of the well to open cracks in the surrounding rock. The hydrofracturing technique had not been demonstrated in granite or other crystalline rock formations. These dry geothermal deposits are believed to constitute a resource at least ten times as large as deposits permeated by ground water. The economic feasibility of the hydrofracturing experiments is discussed. (MCW)

29406 ENERGY NEEDS AND THE ENVIRONMENT. Seale, R. L.; Sierka, R. A. (eds.). Tucson, AZ; University of Arizona Press (1973). 359p.

Traditional political and scientific boundaries of the interrelated problems of energy and the environment are discussed in the book by representatives from government, the energy industry, and academia. The nineteen papers are: The Challenge of Energy Generation; Energy Resources for Power Production; Air Resources; Water Use and Management Aspects of Steam-Electric Generation; Central Station Energy Requirements; Transportation Energy Requirements; Air Quality Criteria; Water Quality Criteria; Present Fossil Fuel Systems and Their Emissions; Present and Future Airborne Emissions Control; Thermal Emissions Control; Present Reactor Systems and Their Emissions; Future Reactor Systems; Fuel Processing and the Environment; Present and Future Radiation Levels; Development of Federal and State Air Quality Control Programs; Environmental Engineering for the Navajo Project; University of California System and Air Pollution Research; and National Goals as described by Weinhold from the Office of Science and Technology in the United States. (auth)

29407 PROCEEDINGS OF THE NATIONAL ENERGY FORUM, WASHINGTON, DC, SEPTEMBER 23-24, 1971. Washington, DC; National Division of the U.S. National Committee of the World Energy Conference (1971). 229p. (CONF-710982-).

After a summary of the energy issues, energy industries (coal, electricity, natural gas, nuclear, oil) are discussed in individual talks: Energy financing is then considered in two talks (commercial bank and investment bank). After a talk on academic energy research and development, individual viewpoints are given by representatives of various government agencies (AEC, Interior, Environmental Quality Council, Emergency Preparedness Office, FPC, Economic Advisors Council, EPA). Finally, an extensive forum of questions and answers is included. (DLC)

29408 ENERGY OUTLOOK: NOW TO 1985. Kruger, P. (Stanford Univ., CA). Aware; No. 36, 3-7 (Sep 1973).

The United States has supported its population expansion, its economic growth, and its high standard of living by means of an accelerating utilization of low-cost energy. Fossil fuels are finite and nonrenewable. The increasing awareness of the exponential growth of energy consumption, the rapid depletion of natural resources, the lagging development of new energy resources and technologies, the strain on the dollar in world markets, and the growing public and institutional demands for energy and materials conservation and environmental protection have forced the government to look for energy economy. Broad studies of projected energy consumption and the possibilities for conserving energy while enhancing the quality of the environment were reported by the National Petroleum Council, 1971-1972. The conclusions are summarized. Other studies by the U. S. Atomic Energy Commission and Dupree and West are cited. The Office of Emergency Preparedness (1972) suggested that energy-conservation measures can reduce U. S. Energy demand by 1980 by as much as the equivalent of 7.3 million barrels of oil per day. Aspects of all energy sources were investigated. (MCW)

29409 ENERGY IN THE CITY ENVIRONMENT. Rickles, R. N. Park Ridge, NJ; Noyes Press (1973). 180p. $12.50.

The energy problems of the New York Metropolitan Area are reviewed, but these problems are identical with those found in every urban area of every developed country. The problems, the potential answers, and the drawbacks associated with them are discussed by representatives from government, business, and the many civic and environmental organizations in New York. Charts in the Appendix present a list of energy conservation measures for the short-term (1972-1975), mid-term (1976-1980), and long-term (beyond 1980) for the transportation, residential/commercial, industrial, and electric utility sectors. The charts also indicate estimated maximum attainable energy savings, possible means for implementing each conservation measure, and the pros and cons. The symposium was sponsored by the New York Board of Trade. (MCW)

29410 HARNESSING SOLAR ENERGY: THE POTENTIAL. Cherry, W. R. (Goddard Space Flight Center, Greenbelt, MD). Astronaut. Aeronaut.; 11: No. 8, 30-36 (Aug 1973).

Solar energy is inexhaustible and can be utilized with minimal impact on the environment. Three ways for the utilization of solar energy are heating and cooling of buildings, production of clean renewable fuels, and generation of electrical power. Improvement of known materials, processes, and engineering is needed. An investment of about two-and-a-quarter billion dollars over a 15-year period in solar conversion and collection technology will make available vast amounts of clean thermal energy and clean gaseous, liquid, and solid fuels to help relieve the dependence upon the unrenewable fossil fuels, particularly foreign sources of them, and thus rectify the balance of payments. By the year 2020 at least 20% (almost the total energy consumption of the USA in 1970) of the USA total energy needs could be met with solar-energy processes. (MCW)

29411 HOW MUCH IN RESERVE. Whittemore, F. C. (Univ. of Virginia, Charlottesville). Environment; 15: No. 7, 16-20; 21-35 (Sep 1973).

Methods of estimating the major fuel resources of coal, oil, gas, and uranium are compared. The goal of this comparison is to recommend change in current-estimation methods for a nation struggling with energy problems. The method for each fuel has strengths and weaknesses. The best features of the different estimates are combined to form the ideal model that includes annual updating, standard definitions, estimation of resources, physical parameters, geographical breakdown, new universal terminology, full disclosure of known data, and productive capacity. It is shown

that the characteristics should be treated as a basis for future consideration and will treat the resource estimation as a whole rather than on a fuel-by-fuel basis. (MCW)

29412 FUEL FROM CITY TRASH. Wilcox, D. Environment; 15: No. 7, 36-42(Sep 1973).

A project in St. Louis, Missouri using city refuse to supplement coal fuel in boiler furnaces that generate electricity is described. The project is sponsored by the city, the Union Electric Company, and the Federal Environmental Protection Agency. Four factors discussed are: the implication of the project for solid waste disposal and resource and energy recovery; the project's applicability on a nationwide scale; the economic aspects; and the environmental considerations. The St. Louis project does not offer a solution to the solid waste disposal, recycling, and the energy crisis. The burning of the garbage produces chlorine-containing emissions. The city plans to sell the magnetically separated ferrous metals, mostly scrap cans, to the nearby Granite City Steel Company, which will use this scrap to replace, on the order of 15 tons per day, iron ore in its blast furnaces. The refuse processing procedure is described. (MCW)

29413 SOLAR ENERGY IN DEVELOPING COUNTRIES: PERSPECTIVES AND PROSPECTS. A Report of An Ad Hoc Advisory Panel of the Board on Science and Technology for International Development. Washington, DC; National Academy of Sciences (1972). 58p.

The Ad Hoc Advisory Panel on the Utilization of Solar Energy in Developing Countries presented the report on the state of the art in utilizing solar energy for developing countries and a review of the current practical applications; the desirability of establishing an international solar energy institute in North Africa to carry out solar energy research and development; and the identification of promising areas for research and development. Solar process applications now being made include solar evaporation, water heating, solar distillation, and solar drying. Solar process applications in experimental stages include space heating, air conditioning or comfort cooling, solar refrigeration, conversion to mechanical or electrical energy, solar cooking, and biological processes. (MCW)

29414 ENERGY FOR THE FUTURE. Report of the Working Party on Energy Resources and Policy. London; Institute of Fuel (1973). 36p.

It is concluded that the availability of reasonably priced oil to meet the projected increased demand over the next 20 years is in doubt. It is recommended that part of this demand should be reallocated to indigenous fossil fuels (particularly coal) and nuclear fuel, leaving oil to supply those markets where no alternative fuel is possible. Detailed proposals are made, including recommendations for the development of nuclear power (a full-scale breeder-reactor-based station to be built as soon as practicable), a foolproof nuclear waste disposal system to be developed as a matter of extreme urgency, and research into fusion power to be substantially increased. The report is in sections: future patterns of fuel usage, fuel reserves, fuel and politics, fuel and the environment, UK reserves and patterns of fuel usage, EEC fuel provision, future development of energy sources (coal, oil, gas, hydroelectricity, and nuclear power), energy policy and the UK. (UK)

29415 METHODS AND APPARATUS FOR THE POLLUTION-FREE GENERATION OF ELECTROCHEMICAL ENERGY. Anbar, M. (to Stanford Research Inst.). U. S. Patent 3,741,809. 26 Jun 1973. Filed date 13 May 1971. 8p.

Methods and apparatus are described for the pollution-free generation of electrochemical energy from coal, hydrocarbons, or other carbonaceous fuels by a cyclic operation wherein a metal such as lead is oxidized in an electrochemical cell delivering electromotive force, with the resulting lead oxide then being reduced in a molten-salt melt within a regeneration chamber by the addition thereto of the fuel. The reduced lead metal is then returned to the cell for the next cycle. A useful salt melt for employment in the regeneration chamber comprises admixed alkali metal carbonates, and preferably a melt of this character is employed both as the vehicle in which the lead is reduced by the fuel as well as for the electrolyte in the cell. Passage of the lead and lead oxide between the respective cell and regeneration zones can be continuous or intermittent. The total operation is carried out without formation of pollutant gases, and only CO_2, N_2, and H_2O vapors are vented. Any sulfur present in the fuel is converted to lead sulfate and is removed from the salt, usually by treatment of a sidestream. (auth)

29416 TECHNOLOGY, THE ENERGY CRISIS, AND OUR STANDARD OF LIVING. Schulman, F. (Atomic Energy Commission, Washington, DC). Mech. Eng.; 95: No. 9, 16-23(Sep 1973).

Cheap energy does most of the work and sustains transportation systems. The rate of technology investment has continuously increased during this century until 1965 when, for the first time, the rate of investment in R & D began to decline and is still declining. There is a definite relationship between standard of living and productive investment. The impact of technology on the dollar is discussed. Delays have developed in the nuclear power field for a variety of technical, mechanical, environmental, and regulatory reasons that have resulted in a shortage of currently available energy. Efficiency in energy use in the immediate years ahead and power generation from fission reactors can assist in the immediate future. The conservative uses and present know-how development of fossil fuels are indicated. In the long term, there is the prospect of nuclear fusion with almost limitless energy possibilities. To provide a high standard of living in the future, it is important that the present downward trend in R & D be reversed. (MCW)

29417 MINIMUM SIZE OF LARGE DRY COOLING TOWERS WITH COMBINED MECHANICAL AND NATURAL DRAFT. Moore, F. K. (Cornell Univ., Ithaca, NY). J. Heat Transfer; 95: No. 3, 383-389(Aug 1973).

The gasdynamic performance equation for large-scale dry cooling towers is derived relating size, shape, fan power, and drag and heat-transfer performance of heat exchangers. Induced-, forced-, or natural-draft towers are special cases. The general result consists of a zero-order scaling formula involving a size function having a minimum for a particular combination of temperatures, together with a set of correction terms of first order in temperature rise. Thus systems that are nearly equivalent gasdynamically can be compared. Technical requirements for small tower size or fan power are expressed in terms of heat-exchanger parameters. (auth)

29418 SENSIBLE USE OF ENERGY: WHY, WHERE, AND HOW. Stoy, B. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen). Elektrizitaetswirtschaft; 72: No. 15, 497-506 (1973). (In German).

From annual meeting of the Vereiningund Deutscher Elektrizitaetswerke e. V.; Duesseldorf, Ger. (22 May 1973).

The anxiety about future sources of energy, the increasing economic dependence due to energy imports, the expenditure on environmental protection, and the economics of electricity generation and transmission furnish the incentive for the efforts initiated by the RWE to reduce the energy expenditure for various purposes without sacrificing production, consumption, or comfort. Applications are determined that are particularly effective quantitatively for the different energy conversion stages in improving the degree of utilization, and then suggestions are put forward for development work, or actual examples given, of power circuits or energy feeders for power applications. (GE)

29419 GAS TURBINES AS PEAK LOAD GENERATORS. Becker, G. (Kraftwerk Union AG, Muelheim an der Ruhr, Ger.). Tech. Mitt.; 66: No. 7, 321-327(1973). (In German).

An investigation was made of the order of optimum costs for electricity generation and load regions as well as of the starting procedure with fast starting systems. The behavior of the following various special systems is described: flight operation works, industrial gas turbines, single-shaft gas turbines, gas turbines especially for peak current generation, gas turbines with exhaust-gas heat usage, combination of gas turbines-steam turbines, and gas turbines-air storage power plants. (GE)

29420 WILL URANIUM SUPPLY BECOME THREE-BALL GAME? After Ratification of the Atomic Nonproliferation Treaty, Uranium also from the USSR. Handelsblatt; 28: No. 68, 3(1973). (In German).

With ratification of the atomic non-proliferation treaty by the European Community, certain reservations have been made as to the Federal Republic's supply of uranium in its nuclear power plants. The Soviet Union, for example, had such reservations prior to the ratification, although she had declared herself prepared to supply the Federal Republic with enriched uranium. Following the latest offers from France and supply from the USA, it seems to the German observer as though the Federal Republic has three balls to play with as far as the uranium supply is concerned. (GE)

29421 POWER ECONOMY IN ITS ECONOMIC AND SOCIAL ENVIRONMENT 1975-1985. Schuermann, H. J. (Univ., Cologne). Brennst.-Waerme-Kraft; 25: No. 7, 282-284(1973). (In German).

From 17th work conference of the Energy-Economic Institute of the University of Cologne; Cologne, Germany (5 Apr 1973).

The conference dealt with the power supply in the FRG in the future. The most important features and data from the lectures are given. (GE)

29422 ENERGY SUPPLY OF THE FUTURE, RATIONAL OR RATIONED. Schaefer, H. (Technische Univ., Munich). Brennst. Waerme-Kraft; 25: No. 7, 291-295(1973). (In German).

The dangers of a false interpretation of the economic facts concerning the problem of energy and environment due to a lack of knowledge of the subject, are presented by means of a few examples. The additional factors necessary for a more rational use of energy based on the balance of the energy consumption of the FDR in 1972 are shown. Problems on the use of the waste heat in thermal generation of electricity are discussed. (GE)

29423 NEW WAYS OF ELECTRIC POWER. Wiss., Wirt., Polit.; 3: No. 30, 3-6(1973). (In German).

The high-capacity transfer of electric enrgy is reviewed and the limiting possibilities are shown. Based on some already-existing examples, the advantages and future prospects of the high-voltage direct-current transmission (HGUE) are given. The siting problems and the possibilities of modern cables (superconducting) are discussed. (GE)

29424 POWER PLANT CONSTRUCTION PROGRAMS AND PROMOTION OF THE POWER ECONOMY. Considerations Concerning the Construction of New Power Plants in the FRG and the Right to Forbid of the Federal Authorities. Marnet, C. (Stadtwerke, Dusseldorf); Determann, H. G.; Stumpf, H. Energ. Tech.; 25: No. 7, 175-181(1973). (In German).

A critical review is given of the present ratio of power generation capacity to system loading in the FRG, of the foreseeable future development and associated risks, and the behavior of the regulatory authorities in the handling of charges brought against the construction of new power plants. Two new studies concerning power plant construction problems that have recently been initiated by the Ministry for Economic Affairs of Northrhine–Westphalia are reviewed. It is shown that the general regulations issued by the federal authorities, governing the block size of new power plants to be built, are contradictory to the objects to be pursued in order to guarantee economic power generation with least harmful effects on the environment, and that this may lead to a bottleneck in energy generation during the next few years, at least as far as novel units limited to a certain capacity are concerned. The authors suggest that existing regulatory procedures be exempted by means of model regulations of the regulations limiting the decision margin of the regulatory authorities, hence enabling individual cases to be treated and discussed separately according to the individual problems involved. (GE)

29425 ELECTRICITY SUPPLY IN AUSTRIA: FROM HYDRO TO NUCLEAR POWER. Warner, E. (Oesterreichische Draukraftwerke A. G., Klagenfurt). VGB Kraftwerkstechnik; 53: No. 8, 499-508(1973). (In German).

The electricity supply system in Austria that hitherto has been predominantly based on hydroelectric power must, to an increasing extent, be reinforced by nuclear power plants. The technical and economic aspects, criteria, and specific problems of this development for the Austrian electricity supply industry are explained. (GE)

29426 LIMITS OF ENERGY PRODUCTION. Gruenn, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). VGB Kraftwerkstechnik; 53: No. 8, 508-515(1973). (In German).

The growth of energy production will presumably continue for a long time. A comparison of the various methods of energy production, energy sources, and their implications shows that reserves of nuclear energy will last for many hundreds of years and that careful design enables nuclear power stations to produce electricity with a particularly small impact on the environment. (GE)

29427 GLOBAL BLUNDER. Vogel, J. C. Nucl. Active; 10-13(Jul 1973).

The pollution of the Earth's atmosphere, land, and oceans by carbon dioxide derived from the combustion of fossil fuels is not necessarily harmful to man, but may change the global climate to such an extent that human existence will be endangered. It is indicated that energy consumption will have to be reduced drastically and that nuclear power should be regarded as the only permissible source of electrical energy if suspected catastrophic changes in nature a mere 100 years hence are to be avoided. (MCW)

29428 METHOD AND SYSTEM FOR CONVERSION OF WATER AND DEVELOPMENT OF POWER. Hancock, B. J.; Johnson, D. E.; Merkley, Z. W. (to Aqualectra of Arizona). U. S. Patent 3,754,147. 21 Aug 1973. Filed date 18 Oct 1971. 12p.

Using the power from ocean waves, air is entrained by the Bernoulli principle and placed under compression. This compressed air is used to drive prime movers and to generate electricity. The generated electricity can be employed to desalt and separate sea water electrolytically into oxygen and hydrogen, and the gases can then be used to produce power and other useful products. The hydrogen that is highly fluid and of low weight can be transported inexpensively to a distance from the sea and then reconverted to water, combining it with atmospheric oxygen, producing substantial energy as well as water. (Official Gazette)

29429 ENERGY CRISIS. Rocks, L.; Runyon, R. P. New York; Crown Publishers, Inc. (1972). 189p.

The role of power and its impending shortage is discussed. Energy cannot be recycled and energy resources are being rapidly depleted. Environmental problems are theoretically solvable: pollution can be largely abated by the same science that created industry, and substantial percentages of materials can be recycled. The chapters in the book are: The Accelerating Power Crisis; Oil: The Gathering International Dangers; The Futility of Our Natural Situation and Strategy; Coal: The Source of Synthetic Fuels; The Eternal Sources of Power: Inaccessible or Insufficient; Our Atomic Energy Program: Too Little Too Late; Nuclear Fusion: An "Ultimate" Answer to Our Future Energy Needs; The Electrical Requirements of a Nuclear Age: We're Unprepared; Population-Food-Energy; Pollution: Fossil Fuels Vs. Nuclear Fuels; Some Misconceptions About Power; A Comparison of Nations; The Politics of Power—International; and The Politics of Power—Domestic. (auth)

29430 AMERICAN APPROACH TO BENEFIT-COST ANALYSIS APPLIED TO THE PRODUCTION OF ELECTRICITY, WHICH TAKES THE ENVIRONMENT INTO ACCOUNT. de Preneuf, R. (CEA, Paris). Energ. Nucl. (Paris); 15: No. 2, 135-138(Mar 1973). (In French).

Benefit–cost analysis is a decision-making tool that enables the desirability of a project to be appreciated in relation to all the available alternatives. The analysis is carried out by evaluating the results of the various projects through their lifetimes and examining the various sectors affected. The benefit–cost analysis made for the installing of a nuclear power plant in La Salle County is presented as an example. The local and regional aspects of the economics of the problem are analyzed separately. This part of the treatment constitutes the originality of the method. The effect on the environment of the different decisions that might be adopted is compared. (FR)

29431 POWER, FRESH WATER, AND FOOD FROM COLD, DEEP SEA WATER. Othmer, D. F.; Roels, O. A. Science; 182: No. 4108, 121-125(12 Oct 1973).

Solar heat energy accumulates in the vast volume of warm tropic seas. The looming energy crisis causes a renewal of interest in utilizing this stored solar heat to give, in addition to electric power, vast quantities of fresh water. Warm surface water, when evaporated, generates steam, to power a turbine, then fresh water when the steam is condensed by the cold water. A great increase in revenues over that from power and fresh water is shown by a substantial mariculture pilot plant. Deep seawater contains large quantities of nutrients. These feed algae that feed shellfish, ultimately shrimps and lobsters, in shallow ponds. Wastes grow seaweed of value; and combined revenues from desalination, power generation, and mariculture will give substantial profit. (auth)

Information Handling

29432 (BNWL-1652) GRAPHIC DIGITIZER PROGRAM TO INTERPOLATE MATRIX GRID VALUES: USERS MANUAL. Friedrichs, D. R. (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1973. Contract AT(45-1)-1830. 48p. Dep. NTIS $5.45.

A quick and efficient method is required for conversion of data from contour form into matrix nodal values. A new computer program was developed which uses a PDP-9 digital computer and a graphic digitizer. Through use of this program a contour map may quickly be converted to matrix form with virtually no errors. This work was performed by the Water and Land Resources Department of Battelle Northwest for application to the Radionuclides in Soils Program sponsored by the Atlantic Richfield Hanford Company. (auth)

29433 (LA-UR-73-1252) NATIONAL TRANSLATIONS CENTER. Godfrey, L. E. (Los Alamos Scientific Lab., N. Mex.). 1973. 5p. (CONF-730926-1). Dep. NTIS $3.00.

From Federal Library Workshop meeting; Denver, Colorado, USA (26 Sep 1973).

A description is given of the National Translations Center, its history, collection, services, and funding. Its relationship to other sources of translations is discussed. The involvement of the Special Libraries Association in the current financial problems of the Center is described, and possible courses of action in behalf of the Center are mentioned. (auth)

29434 (ORNL-UR-113) STATISTICAL PROCESSING SYSTEM FOR THE PUBLIC USE SAMPLES. Levin, M. L.; Mellen, R. E.; Gove, N. B.; Malthouse, W. B. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 75p. Dep. NTIS $5.75.

The SPSS-over-ride system (SOS) described here enables ready access to a generalized statistical processor for research with the U. S. Bureau of the Census's Public Use Samples. Through a series of modifications to the Statistical Package for the Social Sciences (SPSS), provision is made to allow the user to read values from the Public Use Samples (PUS) directly into SPSS and consequently to gain access to its powerful and easy to use statistical capability. A data compression/decompression feature serving to reduce the physical size of the PUS is also provided. Users, at their option, can choose to employ this feature for any given application. The over-ride system maintains the integrity of the PUS documentation. Finally, with the exception of the compression/decompression feature, the system is not restricted to applications with the PUS. SOS allows the user to design ad hoc reading routines for any non-standard file structure, if the structure can be handled in a FORTRAN IV environment. (auth)

Law

29435 (CONF-710501-P1, pp 63-67) AEC IMPLEMENTATION OF THE NATIONAL ENVIRONMENTAL POLICY ACT IN ITS LICENSING AND REGULATION OF NUCLEAR FACILITIES. Rogers, L. R. (Atomic Energy Commission, Washington, D.C.); Henderson, C. L. 1971.

From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971).

In radionuclides in ecosystems.

The Act makes it the continuing responsibility of the federal government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, functions, programs, and resources toward certain stated ends of environmental protection. NEPA does not specifically refer to the licensing activities of federal agencies. The AEC has, however, interpreted the Act to mean that the licensing of nuclear facilities, particularly nuclear power plants and plants for chemical reprocessing of nuclear fuels, is a "major federal action significantly affecting the quality of the human environment." It is concluded that NEPA has the effect of expanding AEC's regulatory jurisdiction and responsibility previously limited by the Atomic Energy Act of 1954, as amended, to the radiological area, into the area of nonradiological environmental effects of AEC-licensed activities. In accordance with this interpretation of NEPA, the AEC has assumed the responsibility for preparing for each proposed nuclear facility, that may significantly affect the quality of the environment, a detailed statement on environmental considerations, and for obtaining the comments of other federal agencies having environmental responsibilities and expertise. (MCG)

Management

29436 (WASH-1228(72)) NUCLEAR ENGINEERING ENROLLMENT AND DEGREE SURVEY. Enrollments, Fall 1971; Degrees Granted, July 1965–June 1971. (Division of Nuclear Education and Training (AEC), Washington, D. C.). Nov 1972. 22p. Dep. NTIS $3.25.

This survey was conducted to determine the total number of students being trained in all engineering fields with nuclear option, as well as in nuclear engineering as such. (12 tables) (DLC)

29437 (WASH-1228(73)) NUCLEAR ENGINEERING ENROLLMENT AND DEGREE SURVEY. Enrollments, Fall 1972; Degrees Granted, July 1965–June 1972. (Division of Nuclear Education and Training (AEC), Washington, D. C.). May 1973. 32p. Dep. NTIS $3.75.

Cumulative data published in the fall 1972 engineering survey are updated and modified to include information from the Air Force Institute of Technology and on the placement of graduates. Comments are given on trends. (DLC)

29438 (WASH-1229(72)) RADIATION PROTECTION ENROLLMENT AND DEGREE SURVEY: FALL 1971. Chewning, J. S.; Strickland, A. E. (Division of Nuclear Education and Training (AEC), Washington, D. C.). Nov 1972. 16p. Dep. NTIS $3.00.

Data on training programs in the fields of radiation health, radiation safety, and related subjects in the USA during 1971 are presented. Data are included on degrees granted from July 1965 through June 1971. (CH)

29439 (WASH-1229(73)) RADIATION PROTECTION ENROLLMENT AND DEGREE SURVEY: FALL 1972. Strickland, A. E. (Division of Nuclear Education and Training (AEC), Washington, D. C.). May 1973. 27p. Dep. NTIS $3.50.

Data on training programs in the field of radiation protection and related subjects in the USA during 1972 are presented. Data are included on degrees granted from July 1965 to June 1972 and placement of the students. The radiation protection options offered by various schools included radiobiology, biophysics, medical radiation physics, health physics, nuclear medicine basic sciences, radiopharmaceuticals, environmental health, environmental radioactivity, aerosol physics, radiation chemistry, and radiology administration. (CH)

29440 PUBLIC WORKS FOR WATER AND POWER DEVELOPMENT AND ATOMIC ENERGY COMMISSION APPROPRIATION BILL, 1974. Part 4. Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-Third Congress, First Session. Washington, D.C.; Joint Committee on Atomic Energy (1974). 1047p.

Mathematics and Computers

Refer also to abstract 29432.

29441 (AERE-R-7136) PAPERS ON SYSTEM DESIGN AND SOFTWARE ENGINEERING. Rimmer, D. E. (ed.). (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 211p. Dep. NTIS (U. S. Sales Only) $12.75. UK 3.50 £.

This report consists of edited lecture notes from a course on System Design and Software Engineering given at AERE in 1971. (auth)

29442 (AERE-R-7470) FORTRAN SUBROUTINE FOR PLOTTING A CUBIC SPLINE FUNCTION. Marlow, S.; Powell, M. J. D. (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

A Fortran subroutine is given that approximates a piecewise cubic polynomial, especially a cubic spline function, by a sequence of straight line segments to prescribed accuracy. The main purpose of the approximation is that it can be drawn directly by most automatic graph plotters to provide a picture of the spline function. This report proves some lemmas on cubic polynomials to justify some techniques of the subroutine that reduce the amount of computation. (auth)

29443 (AERE-R-7477) HARWELL SUBROUTINE LIBRARY. A Catalogue of Subroutines (1973). Hopper, M. J. (comp.) (Atomic Energy Research Establishment, Harwell (England)). Jul 1973. 130p. Dep. NTIS (U. S. Sales Only) $8.50. UK £ 2.50.

A complete list is given of all the subroutines currently in the Harwell Subroutine Library. A brief outline of purpose, method, origin, language, and other attributes is given for each. (MOW)

29444 (HEDL-SA-571) SIMEX: SIMULATION EXECUTIVE WITH AUTOMATIC SCALING. Worth, G. A. 1973. 68p. Dep. NTIS $5.50.

Thesis.

A simulation software package was created for operation on a PDP-9 digital computer. It was designed to utilize a high-level, equation-oriented language in an interactive simulation environment. It utilizes fixed-point calculations with all scaling of constants and equations being done automatically after the user scales the problem variables. All inputs and outputs are in an unscaled number format. The system is structured around a task-oriented, real-time executive which incorporates a line-by-line compiler. The user may input commands either for direct execution or to become part of a stored program. Commands may be input and compiled at the same time that previously entered stored program commands are being executed. The SIMEX system allows any number of time-dependent integrations to be performed (within core limitations). The integration algorithm currently implemented is extremely fast although not as accurate as many more sophisticated algorithims. A simulation benchmark problem was run and it was found that SIMEX provided an execution speed that was eight times faster than any previously published results. SIMEX appears to provide more speed and more interactive capability than any other small digital computer software system currently available. (auth)

29445 (IS-3206) DESIGN AND COMPLETE DEFINITION OF A SYSTEMS PROGRAMMING LANGUAGE FOR DATA COMMUNICATIONS. Niebaum, E. J.; Keller, R. F. (Ames Lab., Iowa). Aug 1973. Contract W-7405-eng-82. 114p. Dep. NTIS $7.75.
Thesis. Submitted by E. J. Niebaum.
A wide range of algorithms related to data communications problems is described in a high-level language. Functions of programmable communications processors are described, and several existing systems programming languages are discussed. A systems programming language is developed with special features for handling data communications. These features include facilities for handling asynchronous input, operators for bit manipulation and shifting, provision for moving multiple characters in storage, and limited address manipulation. The syntax of the language is described in the meta-language, META PI, and the semantics are described using Vienna Definition Language concepts. Finally, a simple data communications environment is defined and a sample program is given to handle message traffic in that environment. (auth)

29446 (LA-5343-MS) LAMPF DATA HANDLING WORKSHOP. Introduction to PDP-11 DOS-8. Amann, J. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 19p. Dep. NTIS $4.00.
The purpose of this document is to enable someone who is not familiar with the PDP-11 to enter, compile, link, and run a FORTRAN program by following the instructions contained herein. It should also provide the user with sufficient familiarity with the organization of the system that more advanced and detailed information may be readily obtained and understood from the appropriate systems manuals. (auth)

29447 (LA-tr-73-26) BRANCHING OF A PERIODIC SOLUTION FROM A STATIONARY SOLUTION OF A DIFFERENTIAL SYSTEM. Hopf, E. Translated from Ber. Verh. Saechs. Akad. Wiss. Leipzig, Math.-Naturwiss. Kl.; 94: 3-22(1942). 24p. Dep. NTIS $3.25.

29448 (RISO-M-1627) USE OF THE DIGITAL PLOTTER IN FORTRAN PROGRAMS ON THE B 6700. Voss, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.
This paper is the Users Guide to utilization of the Digital Plotter in Fortran Programs on the B 6700. The plotter package is described. The package is a set of subroutines, which as a whole enter the SF library under the name SF/150. Some plotter subroutines outside the package are also described. (auth)

29449 (SLA-73-844) NON-PARAMETRIC PREDICTION INTERVALS. Hall, I. J.; Prairie, R. R. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 30p. Dep. NTIS $3.50.
One-sided and two-sided nonparametric prediction limits which are based on the smallest and/or largest ordered observations are derived. Tables which give the probabilities associated with various sample sizes are presented. (auth)

29450 (SU-326-P-30-28) LOWER ESTIMATES FOR THE ERROR OF BEST UNIFORM APPROXIMATION. Meinardus, G.; Taylor, G. D. (Stanford Univ., Calif. Dept. of Computer Science). Jul 1973. Contract AT(04-3)-326. 19p. (STAN-CS-73-376). Dep. NTIS $3.00.
The lower bounds of de La Vallée Poussin and Remes for the error of best uniform approximation from a linear subspace are generalized to give analogous estimates based on k points, k = 1,...,n. (auth)

29451 (UCID-16350) PL/M: A HIGH LEVEL LANGUAGE FOR THE INTEL MCS-8 8008 CPU. Magnuson, W. G. Jr.; Allison, T. G. (California Univ., Livermore. Lawrence Livermore Lab). 14 Aug 1973. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.
This report is a user's manual for the CDC-7600 computer program PL/M. A reference manual for the PL/M language "A Guide to PL/M Programming" is available from the Manufacturing and Materials Group, Electronics Engineering Department. PL/M is a high level language and is structurally similar to IBM's PL/1. In particular it resembles the XPL language. From the high level language input PL/M checks for syntactical and system violations in Pass One. In Pass Two the program generates 8008 "BNPF" data, a map of the original statements versus memory locations, a relocated symbol table address listing, and a list of the assembly language generated by the compiler. Pass Two also does the actual code generation for the MCS-8 8008 CPU. PL/M allows programming in a high level language rather than in assembly language. The programs produced with PL/M will execute on the MCS-8 CPU with little or no loss in execution efficiency when compared to assembly language programming. Likewise, the programs should be easier to maintain as well as a great deal faster to develop. (auth)

29452 (UCID-16351) SIMULATOR PROGRAM FOR THE INTEL MCS-8 800 CPU. Magnuson, W. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Mar 1973. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.
The INTEL 8008 CPU simulator program is now available on the LLL OCTOPUS CDC-7600 computer system. The program (MCS8SIM) provides a software simulation together with simulator execution commands to aid in program development for the MCS-8. Besides accepting 8008 machine code the simulator allows: Manipulation of the simulated memory and 8008 registers, breakpoint insertion, program tracing, symbolic and numeric dumps, single stepping, and other operations during the simulation. This report states how the simulator (MCS8SIM) is accessed and how it is run on the OCTOPUS network. The INTEL manual "8008 Simulator Software Package" appears as appendix A and describes the simulator, the simulator commands and error messages, and presents examples. A few differences in usage exist between the INTEL manual examples and the use at LLL. These differences are pointed out. The program is called MCS8SIM at LLL rather than INTERP/8 as in the INTEL manual. (auth)

29453 (UCID-30001(Rev.2)) GEAR: ORDINARY DIFFERENTIAL EQUATION SYSTEM SOLVER. Hindmarsh, A. C. (California Univ., Livermore. Lawrence Livermore Lab.). 20 Aug 1972. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.
GEAR is a package of subroutines for the numerical solution of systems of ordinary differential equations, given the initial values. It is particularly well suited for stiff systems but can be used generally. The package contains both the implicit Adams methods and the linear multistep methods of C. W. Gear as options, and is based on a program written by Gear. (auth)

29454 (UCID-30061) SIMULATOR FOR THE PDP-8/E COMPUTER. Zucconi, L. (California Univ., Livermore. Lawrence Livermore Lab). 23 May 1973. Contract W-7405-eng-48. 14p. Dep. NTIS $3.00.
The DEC PDP-8/E computer is simulated by a program that is run on a CDC 7600 computer via the LLL Octopus time-sharing system. The user, interacting from an Octopus teletypewriter, can make use of the simulator's debug features to debug a PDP-8/E code. The simulator gives informative error messages and PDP-8 memory dumps, and it has a break-point feature, a memory-relative-usage table, and other aids to debugging. (auth)

29455 (UCID-30064) GATOR USER'S MANUAL. Fletcher, J. G. (California Univ., Livermore. Lawrence Livermore Lab). 3 Aug 1973. Contract W-7405-eng-48. 38p. Dep. NTIS $3.75.
The Gator operating system is a subsystem of the Hydra operating system implemented on the LLL PDP-10 processors. There is an independent Gator system on each of the two processors (P, Q). Each system consists of a single Hydra process which executes whenever Hydra would otherwise be idle. Gator is the only part of the Hydra system that accommodates interactive users. The user need not be aware of the interaction between Gator and Hydra. It is assumed that the reader is familiar with the instruction set and other programming features of the PDP-10 (including the minor modifications peculiar to the LLL processors), with the general structure of the LLL Octopus network, and with the Elephant filing system. (auth)

29456 (UCID-30069) MINI-SCEPTRE: A COMPUTER PROGRAM FOR ELECTRONIC CIRCUIT ANALYSIS. Carter, H. W. (California Univ., Livermore. Lawrence Livermore Lab). 13 Aug 1973. Contract W-7405-eng-48. 40p. Dep. NTIS $4.00.
This manual describes MINI-SCEPTRE—a more efficient version of SCEPTRE, the well-known program for computer-aided electronic circuit design—as it is used at the Lawrence Livermore Laboratory (LLL). The manual (1) presents the input language for SCEPTRE, (2) describes the control of SCEPTRE from a TTY terminal at LLL, and (3) gives results from several detailed examples. Active device modeling and other unique features of the program are also described. The manual is written as both a primer for the uninitiated and a reference manual for experienced SCEPTRE users. (auth)

29457 (UCID-30075) FORTRAN-CALLABLE TEKTRONIX 4010 PLOTTING ROUTINES FOR THE MODCOMP III COMPUTER. Geertgens, C. M. (California Univ., Livermore. Lawrence Livermore Lab). 10 Sep 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $3.00.
The TEKTRONIX 4010 plotting routines described were written for a MODCOMP III digital computer system. The computer system is an integral part of the Direct-Digital Multiple-Actuator-Shaker

Control System located at Site 300. The MODCOMP III is an 800-nanosecond 16 bit computer with floating point hardware and up to 64K words of directly addressable memory. The system includes a VERSATEC printer/plotter, a 1.2-million word disc, a magnetic tape transport, a 300 CPM reader, a high-speed paper tape reader/punch, a teletype, and a TEKTRONIX 4010 Display Terminal. The plotting routines described allow one to plot data curves and write text on the TEKTRONIX 4010 Display Terminal. The operator can interact with the computer via the crosshair cursor on the terminal The CRT routines are FORTRAN-callable, but are written in both FORTRAN and MODCOMP assembly language. They can be implemented on any MODCOMP computer system which utilizes the TEKTRONIX 4010 Terminal. This report is intended to be a user's manual and not a detailed programming or hardware description. (auth)

29458 (UCRL-51420) SOLUTIONS OF THE SCALAR HELMHOLTZ EQUATION IN THE ELLIPTIC-CYLINDER COORDINATE SYSTEM. Lytle, R. J.; Lager, D. L. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Jul 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

A method is described for determining the eigenvalues for the scalar Helmholtz equation in the elliptic-cylinder coordinate system. Complex expansion parameters are considered so that numerical results for physical problems involving energy dissipation as well as energy flow can be obtained. Sample numerical results are presented for the eigenvalues, radial eigenfunctions, and angle eigenfunctions. Applications of these results are discussed. (auth)

29459 (UCRL-74869) PARALLEL APPROACH TO COMPILATION. Zosel, M. (California Univ., Livermore. Lawrence Livermore Lab.). Jul 1973. 14p. (CONF-731001-2). Dep. NTIS $3.00.

From symposium on principles of programming languages; Boston, Massachusetts, USA (1 Oct 1973).

In the programming languages area, work in "vectorizing" problems has included incorporation of vector extensions into languages and also the recognition of FORTRAN DO loops that can be collapsed into vector instructions. Another area for attention is vectorizing the compiler itself. This project was undertaken in 1972 by the language group at Lawrence Livermore Laboratory. The APL-STAR compiler project must actually be considered experimental in several different, but related, aspects. This paper concentrates on the compilation of a program using vector instructions, but the other aspects of the project also enter into the discussion and are briefly introduced. (auth)

29460 (Y-1883) ULTRASONIC NONDESTRUCTIVE TESTING SYSTEM AUTOMATION. Gray, D. H.; Darby, D. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 10 Sep 1973. Contract W-7405-eng-26. 63p. Dep. NTIS $5.45.

A commercial ultrasonic test facility has been interfaced to a medium-sized multiuser computer. The large volumes of data, formerly correlated to flaw size and flaw location manually, are now automatically accumulated and analyzed, and the results are plotted within a matter of minutes. The control system is capable of positioning the ultrasonic transducer with four degrees of motion-three linear and one angular. The data handling system offers the flexibility to allow implementation of nearly any future test requirements. The system is now operational and is in daily use in a development laboratory. Surfaces of revolution and flat plates have been inspected with good results. Fourier transforms of ultrasonic waveforms are handled routinely. The multiuser computer configuration gives the user the impression of having a dedicated computer at his disposal. (auth)

Miscellaneous

29461 (AEC-tr-7454) RELATIONS BETWEEN TRANSPORT COEFFICIENTS: A SYSTEMATIC SCHEME BASED ON THE THEORY OF THERMODYNAMICS OF IRREVERSIBLE PROCESSES. Stephan, K.; Lucas, K. Translated from Int. J. Heat Mass Transfer; 14: 547-559(1971). 19p. Dep. NTIS $3.00.

A systematic deduction of interrelations between transport coefficients is given according to the macroscopic theory of irreversible thermodynamics. The limitations of the theory are discussed and a simple formula for the number of such correlations is derived. The application of the general scheme is demonstrated in a polynary system with an external force as well as gradients of temperature and concentration. (auth)

29462 (ANCR-1121) SHRINKAGE EVALUATION IN MECHANIZED WELDED 16-INCH-DIAMETER CIRCUMFERENTIAL PIPE JOINTS. Downey, J. C.; Hood, D. W.; Keiser, D. D. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1973. Contract AT(10-1)-1375. 43p. Dep. NTIS $4.00.

Weld joint shrinkage resulting from mechanized pipe welding of three different weld joint configurations utilizing two different mechanized welding methods is investigated. The investigation involves 16-inch-diameter, ½-inch-wall-thickness stainless steel pipe; results are used to correlate welding technique and joint design with longitudinal and diametral joint shrinkage. (auth)

29463 (BC-TOP-9(Rev.1)) DESIGN OF STRUCTURES FOR MISSILE IMPACT. Linderman, R. B.; Fakhari, M.; Rotz, J. V.; Thomas, E.; Tuveson, G. A.; Yeh, G. C. K. Jul 1973. 90p.

This report contains methods and procedures for evaluating the effects of missile impact on structures. A means to evaluate the change of velocity of a missile passing through a liquid is also included. Missile impact effects on structures are evaluated in terms of local damage (penetration, perforation, and spalling) and structural response. Empirical formulas are used to evaluate local effects. Structural dynamic principles are used to evaluate structural response. (auth)

29464 (BDX-613-678) HYBRID MICROCIRCUIT PHOTOLITHOGRAPHIC PROCESS. Schantz, L. E. (Bendix Corp., Kansas City, MO). Jul 1973. Contract AT(29-1)-613. 90p. Dep. NTIS $6.50.

A photolithographic process for the production of hybrid microcircuits has been developed through a study of commercial photoresists, processing methods, and processing parameters. Shipley AZ1350H positive photoresist is used for the delineation of electrical circuits having a maximum line-width deviation of two percent or 0.0001 inch (2.54 μm) on unglazed, alumina ceramic substrates metallized with gold, chromium, and tantalum nitride. Process consistency is maintained through control of the prebake time-temperature product, the total exposure light-energy, and the product of the developing time and the solution concentration. Cleanliness is essential, but pinholes do not affect resistor stability. Recommended production methods include systems for photoresist spray- or roller-coating, conveyorized infrared prebake, off-contact exposure, spray-developing, spray-etching of the gold, and automated handling of the substrates. (auth)

29465 (BDX-613-825) RECOMMENDED SCREW TORQUES FOR 0.6, 0.8, AND 1.0 UNIFIED NATIONAL MINIATURE THREADS. Elder, C. W. (Bendix Corp., Kansas City, MO). Jul 1973. Contract AT(29-1)-613. 43p. Dep. NTIS $4.25.

Maximum torques for 0.6, 0.8, and 1.0 Unified National Miniature (UNM) screw threads have been established. During the study (which included investigations of the effects of lubrication, material, length of thread engagement, and screw head style) an Analysis of Variance found that only screw size significantly affected failure torque values. It was found that screws could be torqued to the recommended value, removed, and reinstalled with the same torque without galling or thread damage. (auth)

29466 (BDX-613-914(Rev)) WOVEN-WIRE TAPE VENDOR DEVELOPMENT FY 73-3. Quarterly Report. Chambers, D. H. (Bendix Corp., Kansas City, Mo.). Aug 1973. Contract AT(29-1)-613. 14p. Dep. NTIS $3.00.

Vendors are being assisted in their development of processes necessary to produce woven-wire tape. To improve the control of the weaving process, a creel was designed and fabricated and initial process prove-in activities were completed. (auth)

29467 (BDX-613-996) ULTRASONIC TINNING OF COMPONENT LEADS. Technological Spinoff Report. Mulholland, W. A. (Bendix Corp., Kansas City, MO). Feb 1971. Contract AT(29-1)-613. 28p. Dep. NTIS $3.50.

Ultrasonic soldering was investigated to eliminate the need for using strongly activated solder fluxes during the hot-tinning of component leads. The results indicate that the technique is suitable for tinning the difficult-to-solder materials encountered in production. (auth)

29468 (BNL-18123) MALEYLACETONE CIS-TRANS ISOMERASE. Reaction via a Non-Schiff Base Mechanism. Wong, G.; Seltzer, S. (Brookhaven National Lab., Upton, N. Y.). 1973. Contract AT(30-1)-16. 17p. Dep. NTIS $3.00.

Purified maleylacetone cis-trans isomerase treated with sodium borohydride in the presence of [1-^{14}C]maleylacetone or [2-^{14}C]maleylacetoacetate leads to no substantial attachment of radioactivity to the enzyme. These results appear to rule out a Schiff base mechanism for enzymic catalysis. (auth)

29469 (BNWL-1751(Pt.2), pp 16-18) TRACE ELEMENT CONCENTRATIONS IN SEAL AND PENGUIN. Robertson, D. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the

USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29470 (BNWL-1751(Pt.2), pp 19-20) ELEMENTAL CONCENTRATIONS IN PELAGIC SEDIMENTS. Rancitelli, L. A.; Robertson, D. E. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29471 (BNWL-1751(Pt.2), pp 20-21) CONCENTRATION TECHNIQUE FOR CHLORINATED HYDROCARBONS IN SEAWATER. Petersen, M. R. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29472 (BNWL-1751(Pt.2), pp 22) GEOCHEMICAL OCEAN SECTIONS STUDY. Robertson, D. E. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29473 (BNWL-1751(Pt.2), pp 25-26) MERCURY ANALYSIS OF SEAWATER BY COLD VAPOR ATOMIC ABSORPTION SPECTROMETRY. Robertson, D. E.; Evans, D. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29474 (BNWL-1751(Pt.2), pp 33) DETERMINATION OF COPPER AND CADMIUM IN MARINE SAMPLES USING ATOMIC ABSORPTION SPECTROMETRY. Langford, J. C. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29475 (BNWL-1751(Pt.2), pp 33-34) PROPOSED METHOD FOR MEASURING CHLORINATED PESTICIDES IN RAINWATER. Petersen, M. R. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29476 (BNWL-1751(Pt.2), pp 34-36) STUDY OF MERCURY IN BIOLOGICAL SAMPLES. Langford, J. C. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29477 (BNWL-1751(Pt.2), pp 64-65) GAS-LIQUID CHROMATOGRAPHY APPLIED TO ENVIRONMENTAL PROBLEMS. Petersen, M. R. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29478 (BNWL-1751(Pt.2), pp 69-71) INERT TRACER STUDIES IN THE NATIONAL HAIL RESEARCH EXPERIMENT. Young, J. A.; Thomas, C. W.; Wogman, N. A. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29479 (BNWL-1751(Pt.2), pp 72-74) INERT TRACER AND POLLUTION STUDIES DURING METROMEX. Young, J. A.; Tanner, T. M.; Thomas, C. W.; Wogman, N. A. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29480 (BNWL-1751(Pt.2), pp 78-80) COMPARISON OF THE PARTICULATE POLLUTANT LEVELS AT PROPOSED BASELINE MONITORING STATIONS. Ludwick, J. D.; Young, J. A.; Rancitelli, L. A.; Davis, W. E. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29481 (BNWL-1751(Pt.2), pp 108) TISSUE CULTURE. Schneiderman, M. H. Apr 1973.
In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 2.

29482 (BNWL-SA-4716) AIRBORNE MEASUREMENTS OF THE SIZE DISTRIBUTION AND THE CONDENSATION AND ICE NUCLEATING ABILITY OF PARTICLES PRODUCED BY AgI CONTAINING PYROTECHNICS AND ACETONE SOLUTION BURNERS. Alkezweeny, A. J.; Radke, L. F. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug 1973. Contract AT(45-1)-1830. 15p. (CONF-730936-1). Dep. NTIS $3.00.
From eighth international conference on nucleation of the IAMAP (ICCP); Leningrad, USSR (23 Sep 1973).

29483 (CEA-R-4381) CONTRIBUTION TO THE STUDY OF THE MOLECULAR INTERACTIONS OF GASEOUS HYDROFLUORIC ACID. Ostorero, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug 1973. 185p. (In French). Dep. NTIS (U.S. Sales Only) $11.25.
Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

29484 (CEA-R-4484) MAINTAINABILITY STUDY OF THE FREQUENCY METER-COUNTER FERISOL HB.210. Blin, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1973. 50p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

29485 (CEA-R-4487) MAINTAINABILITY STUDY OF THE INTERTECHNIQUE PLURIMAT-20 ANALYZER. Blin, A.; Francois, B. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1973. 83p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.
The following areas of work are outlined: the objectives of the study; elements for the possible orientation of a maintainability study with a practical guide of what is feasible; duration, cost and influence on the purchase or sale price of the equipment; the interest of the failures simulation, which corresponds to a fruitful and very efficient accelerated method of acquisition of technical data. The analysis of the repair times and the related observations permit to give estimations (M.T.T.R., material resources, instructions, etc.); and the value that can thus be added to the equipment and the benefits of a study of this type. (auth)

29486 (CONF-730616-2) PORE STRUCTURES INDUCED BY WATER VAPOR ADSORBED ON NON-POROUS LUNAR FINES AND GROUND CALCITE. Gammage, R. B.; Holmes, H. F.; Fuller, E. L. Jr.; Glasson, D. R. (Oak Ridge National Lab., Tenn.; Plymouth Coll. of Technology, Devon (England)). 1972. 18p. Dep. NTIS $3.00.
From 47th national colloid symposium; Ottawa, Ontario, Canada (18 Jun 1973).
Lunar fines and the ground calcite are both highly defective materials and because of this there are marked similarities between their interactions with adsorbed water vapor. The solar radiation and meteorites incident on the lunar surface produce soil particles, or fines, which are non-porous to adsorbed inert gas molecules. Many crystalline grains contain very high densities of damage tracks ($>10^{11}$ tracks/cm^2), and show an amorphous coating. The adsorption isotherm of water shows that the fines interact strongly with water vapor. The subsequent adsorptions of nitrogen and argon show that the specific surface area has increased as much as three-fold, and that pores have been generated. The probable explanation for these changes is that water interacts with the amorphous coating and diffuses along the damage tracks leaching a system of microchannels. (auth)

29487 (CONF-730914-1) DETERMINATION OF GAS PHASE/LIQUID PHASE (OR OTHER) DISTRIBUTION COEFFICIENTS BY ANALYSIS OF ONE PHASE ONLY. Feldman, C. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.
From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973).
The derivation of the distribution coefficient of a chemical species between two phases is phrased in terms of a liquid phase/gas phase distribution equilibrium, but the formulas obtained apply equally well to a distribution between any two phases. (JFP)

29488 (COO-1436-38) TRANSPORT AND THERMODYNAMIC PROPERTIES OF SOLIDS. Progress Report, September 1, 1972–August 31, 1973. Grace, R. E.; Dayananda, M. A. (Purdue Univ., Lafayette, Ind. (USA). School of Materials Engineering). 1973. Contract AT(11-1)-1436. 26p. Dep. NTIS $3.50.
The principal area of research is ternary diffusion in solid-solution alloys. Data are given for diffusion in the Cu–Zn–Ni system. (DLC)

29489 (COO-2056-7) PALEOCLIMATIC INTERPRETATION OF POSTGLACIAL FLUCTUATIONS OF THE BRISTLECONE PINE TREELINE. I. History of the Bristlecone Pine Treeline. Final Report, June 1, 1969–July 31, 1972. LaMarche, V. C. Jr. (Arizona Univ., Tucson. Lab. of Tree-Ring Research). 1972. Contract AT(11-1)-2056. 6p. Dep. NTIS $3.00.

29490 (COO-3029-7) ANNUAL PROGRESS REPORT, JUNE 1, 1972–JUNE 30, 1973. Turkevich, J. (Princeton Univ., N. J.). 1973. Contract AT(11-1)-3029. 10p. Dep. NTIS $3.00.

Activities of the various people associated with the project are summarized and a listing of publications resulting from the research is given. (DHM)

29491 (COO-3161-15) ONE-PHONON SPECTRAL FUNCTION FOR SOLID HELIUM. McMahan, A. K.; Beck, H. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Jun 1973. Contract AT(11-1)-3161. 35p. Dep. NTIS $3.75.

Approximate numerical calculations are used in order to understand some of the differences in size and shape of secondary structure obtained in calculations of the one-phonon spectral function for solid helium which have been reported in the literature. It is seen that Horner's self-consistent treatment of the bubble diagram significantly increases the size of such structure over that obtained in perturbative calculations such as used by Glyde and co-workers. A computational procedure used by Horner in evaluating the spectral function may also further enhance the appearance of secondary peaks in the tail region. Previous explanations of these secondary peaks are reviewed and criticized. Other calculations of the one-phonon spectral functions for the solid heliums are briefly discussed. (auth)

29492 (COO-3514-1) ION MOBILITY IN MOLTEN SALTS. Final Report. Laity, R. W. (Rutgers–The State Univ., New Brunswick, N. J.). 1971. Contract AT(11-1)-3514. 55p. Dep. NTIS $4.75.

Research is reported on a study of the factors controlling the rates at which ions in molten salts move under the influence of applied forces. Progress has been made in number of areas, including "concepts of ion mobility", characteristics of mobility in pure salts, significance of external mobilities, and characteristics of mobility in binary salt mixtures. Of particular significance was the discovery (and interpretation) of the very strong concentration dependence of the relative electrical mobilities of two cationic species in simple binary mixtures. This effect has been found to be much larger than the corresponding behavior of diffusion mobilities. Like most other observations in the areas listed, however, this characteristic of molten salt mobilities has not yet been given a generally accepted or definitive explanation. (auth)

29493 (COO-3631-5) EXPERIMENTAL STUDIES OF CRITICAL POINT BEHAVIOR IN MAGNETICALLY ORDERED SOLIDS USING NUCLEAR GAMMA-RAY SPECTROSCOPY AND RELATED EXPERIMENTS. Final Report, February 1, 1967–October 31, 1972. Hohenemser, C. (Clark Univ., Worcester, Mass. (USA). Dept. of Physics). 1973. Contract AT(30-1)-3823. 20p. Dep. NTIS $3.00.

The principal object of study was Ni; the principal techniques time-differential perturbed angular correlations and Moessbauer Effect. Both static and dynamic critical phenomena studies are reported. Systems on which work was done include ^{57}Fe in Ni, ^{44}Sc in Ni and Fe, and ^{100}Rh in Ni. (DLC)

29494 (EUR-4958) THERMAL DECOMPOSITION OF WATER THROUGH CHEMICAL CYCLES USING A Fe–Cl_2 FAMILY. Hardy-Grena, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Jun 1973. 15p. (In French). Dep. NTIS (U. S. Sales Only) $3.00. EUR FB 25,-.

29495 (IS-T-579) DROP SHAPES AND INTERNAL FLOW PATTERNS BY NUMERICAL SOLUTION OF THE NAVIER–STOKES EQUATIONS. Sandry, T. D. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 166p. Dep. NTIS $10.50.

Thesis.

The shape of and flow patterns within a hypothetical separating drop were determined by numerical solution of the Navier-Stokes equations. The drop was hypothetical in the sense that it separated because the surface tension force restraining it was reduced at the start of calculation. However, the velocity distributions and shape of the drop resemble those of an actual drop as it separates. Considerable surface stretch was observed at the sides of the drop and very little at the apex. The flow pattern within the drop was found to approach plug flow in the direction of gravity when the drop began to stretch out. These results were also observed when a surface tension force was applied at the interface. The flow patterns within a constant volume forced internal circulation drop were also determined numerically for various flow rates and viscosities. Increasing the viscosity while holding flow rate constant caused a transition in flow pattern from rotating to nonrotating flow. A similar change in flow pattern was observed when viscosity was held constant and flow rate decreased. However, a complete lack of rotation was not reached in this manner. Very little mixing was observed even at the highest velocity (1 centimeter per second) and lowest viscosity (1 centipoise). These flow patterns indicate that a penetration theory mass transfer model would be appropriate for this system. Several modifications to the MAC method are also presented. Most of the modifications deal with the location at which the free surface pressure boundary conditions are applied, but some changes were also necessary in the method of surface tension force calculation, and in velocity extrapolation at the free surface. Without all of these modifications it would not have been possible to simulate drop motions using the MAC method. (auth)

29496 (IS-T-584) CRYSTAL AND MOLECULAR STRUCTURES OF π $C_5H_5Fe(CO)_3PF_6$ AND TWO INSECTICIDES, DIELDRIN, AND ENDRIN; AN X-RAY AND NEUTRON STUDY OF $K_2Sb_2(d\text{-}C_4H_2O_6)_2 \cdot 3H_2O$. Gress, M. E. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 125p. Dep. NTIS $8.25.

Thesis.

29497 (IS-T-600) DENSITIES, PARTIAL MOLAL VOLUMES, AND EXPANSIBILITIES OF SOME AQUEOUS RARE EARTH CHLORIDE SOLUTIONS FROM 5° TO 80°C. Habenschuss, A. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 318p. Dep. NTIS $18.00.

Thesis.

Solutions of $PrCl_3$, $NdCl_3$, $SmCl_3$, $GdCl_3$, $DyCl_3$, $ErCl_3$, and $YbCl_3$ were studied over the content range 0.1 to 3.5 molal. (DLC)

29498 (IS-T-601) HIGH-PRESSURE LIQUID CHROMATOGRAPHY OF PHENOLS AND METAL IONS. Willis, R. B. (Ames Lab., Iowa). Sep 1973. Contract W-7405-eng-82. 116p. Dep. NTIS $8.00.

Thesis.

A liquid chromatograph is described that uses methanol–water or basic aqueous solutions and Amberlite XAD-7 resin for the separation of phenol and substituted phenols. A specific, sensitive method was developed for determining bismuth. Separation of Hg(II), Bi(III), and Sb(III) ions was also achieved using HBr and cation exchanger. (DLC)

29499 (ISS-72/15) ANALYSIS OF THE MOLECULAR WEIGHT DISTRIBUTION OF DEXTRAN PREPARATIONS FOR CLINICAL USE. Frontali, C.; Araco, A.; Notargiacomo, S. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 13 Nov 1972. 44p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.25.

The molecular weight distribution of a preparation of Dextran 40 was studied by means of two independent procedures. In the first, high and low molecular weight components are precipitated separately, and their average molecular weight is determined by intrinsic viscosity measurements. The second procedure makes use of gel-filtration on Sephadex and of dextran samples of known molecular weight to convert the elution profile in a molecular weight distribution. This latter procedure yields more detailed and reliable data. (auth)

29500 (ITF-73-41-E) SPECTRAL THEORY OF KIRKWOOD-SALZBURG EQUATIONS IN FINITE VOLUME. Pastur, L. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Kirkwood-Salzburg integral equations for the correlation functions of continuous and lattice classical systems in finite volume are studied. It is shown that the operator determined by these equations has the discrete spectrum coinciding with the set of complex numbers $\{Z_i^{-1}\}$ where Z_i, $i = 1, 2, \ldots$ are zeroes of the grand partition function of the system. (auth)

29501 (ITF-73-47-P) GROUP THEORY IN MULTIELECTRON PROBLEMS. Olekseev, M. R.; Tovstyuk, K. V. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The group-theoretical method of construction of the effective (model) Hamiltonian is suggested. The selection rules for the Green's functions are obtained. (auth)

29502 (ITF-73-48-P) LECTURES ON PHYSICAL KINETICS. Akhiezer, A. I.; Bar'yakhtar, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 29p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

A systematic account is given of basic considerations of the gas-kinetic theory. (auth)

29503 (ITF-73-49-P) THEORY OF TRANSFER PHENOMENA IN GASES. Akhiezer, A. I.; Bar'yakhtar, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 44p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

A systematic account is given of the theory of transfer phenomena in gases. (auth)

29504 (ITF-73-50-P) THEORY OF TRANSFER PHENOMENA IN EXTERNAL FIELDS. Virchenko, Yu. P.; Tsukanov, V. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Using the generalized ergodic relation the integral equation is obtained for hydrodynamic density matrix in the presence of the external electromagnetic and magnetic fields. The iteration procedure is formulated which allows one to solve the obtained equations in any approximation with respect to inhomogeneities and magnetic field. (auth)

29505 (ITF-73-63-E) ON THE FIELD FORMULATION OF EQUILIBRIUM CLASSICAL STATISTICAL MECHANICS. I. One Dimensional Gas. The Simplest Pair Potential. Skrypnik, W. I. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The classical equilibrium statistical physics is considered as a peculiar model of nonpolynomial quantum field theory. It is established that the pressure is the lowest eigenvalue of a certain operator, which is an analog of the Hamiltonian of quantum systems. (auth)

29506 (ITF-73-65-E) TIME OPERATOR. Non-Relativistic Case. Olkhovskii, V. S.; Recami, E.; Gerasimchuk, A. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that a "good" time operator exists, $\hat{t} = [-(i/2)](\partial/\partial E)$ that acts onto a space P of L^2-functions and is Hermitian (but not self-adjoint); is canonically conjugated to the (kinetic) energy; and satisfies Ehrenfest's principle. (auth)

29507 (JAB-99-59) REPORT ON RACKING TESTS OF LOW-RISE WALL PANELS. Raggett, J. D.; Ellis, K. N. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Sep 1973. Contract AT(26-1)-99. 86p. Dep. NTIS $5.45.

The panels, in a racking frame, were first subjected to low-frequency (0.1 Hz) cyclic tests over seven deflections ranging from $1/32$ to 1 inch. They were then returned to zero displacement and statically tested to failure. Cyclic testing both allowed a comparison to cyclic stiffness and gave valuable ultimate strength data at larger deflections. Results are presented by means of load-displacement and damping-displacement curves for each panel tested. Summary curves are presented for comparison of all low-rise test panels. (auth)

29508 (LA-5389-PR) DEVELOPMENT OF AIR SAMPLING TECHNIQUES. Quarterly Report, April 1–June 30, 1973. (Los Alamos Scientific Lab., N. Mex.). Aug 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

A silica gel tube was developed which will sample aniline in air of any humidity at concentrations up to seven times the TLV level for eight hours. The pressure drop of this tube is low enough to allow the use of personal sampling pumps currently available. Gas chromatography analysis of the ethanol eluent of such a tube was extended to allow the simultaneous measurement of aniline, N,N-dimethylaniline, o-toluidine, o-chloroaniline, xylidine, o-anisidine, p-anisidine, and p-nitroaniline. Methanol was found to be an interference in the sampling of formaldehyde in air by adsorption on alumina. Sampling tubes containing larger amounts of alumina sorbent are being used to overcome this interference. The analytical method for determining formaldehyde on alumina was modified so that multiple analyses of an air sample are possible. (auth)

29509 (LA-UR-73-1261) LASER-STIMULATED CHEMISTRY IN CHEMICAL LASERS. Robinson, C. P. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 9p. (CONF-730834-1). Dep. NTIS $3.00.

From seventh international conference on photochemistry; Jerusalem, Israel (29 Aug 1973).

The photoignition of chemical lasers has been a standard technique for uniform-volume initiation using flash lamps and ultraviolet lasers. Recent work on stimulating chemical reactions with infrared lasers offers new possibilities for laser ignition. A review of recent experimental work of the chemical laser research and development group will be presented. (auth)

29510 (LBL-1028) FOURIER TRANSFORMS AND THE HUMAN VISUAL PROCESS: AN APPROACH VIA OPTICAL ILLUSIONS. Pearlman, A. L. (California Univ., Berkeley. Lawrence Berkeley Lab.). 16 Jun 1972. Contract W-7405-eng-48. 156p. Dep. NTIS $10.00.

Thesis.

Much interest has been expressed, of late, in the possible involvement of the Fourier transform in the primate visual process. Such involvement is investigated here, via Fourier transformation of well known optical illusions, which are used as inputs to a Fourier model of the visual process because they constitute known failures of the real visual system. Through study of such failures, knowledge of the working system may be gained, as is the case in the field of genetics, where mutations have been valuable tools of research. The essential features of the visual pathway are outlined, and an extensive introduction to the Fourier transform and its applications presented. (LMT)

29511 (LBL-1743) APPLICATION OF X-RAY FLUORESCENCE TECHNIQUES TO MEASURE ELEMENTAL COMPOSITION OF PARTICLES IN THE ATMOSPHERE. Jaklevic, J. M.; Goulding, F. S.; Jarrett, B. V.; Meng, J. D. (California Univ. Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 31p. (CONF-730403-5). Dep. NTIS $3.75.

From 165th meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

29512 (LBL-1822) PHOSPHORESCENCE MICROWAVE DOUBLE RESONANCE STUDIES OF THE LOWEST EXCITED TRIPLET STATE OF p-DICHLOROBENZENE. Panos, R. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 143p. Dep. NTIS $9.25.

Thesis.

Phosphorescence microwave double resonance (PMDR) spectra of p-dichlorobenzene (DCB) neat crystal were obtained monitoring low temperature (~1.3°K) trap phosphorescence and used to make symmetry assignments of various vibronic bands present in the spectra. In addition, ratios of radiative rate constants of individual triplet spin-sublevels to several vibrational states, the intrinsic lifetimes of all three triplet spin sublevels, and selective polarized phosphorescence from individual spin sublevels in various vibronic transitions were measured. An analysis of these data is presented along with explicit considerations of the p-chlorine perturbation on the aromatic ring. Finally, the relations between the orbital symmetries and the sign and magnitude of the zero-field electron spin dipolar interactions in the triplet state are discussed and on these bases an assignment of the orbital symmetry of the lowest excited triplet state of p-dichlorobenzene is made. (auth)

29513 (LBL-2099) TECHNIQUES FOR CONTINUOUS MONITORING OF HYDROCARBONS. Mack, D. A.; Hollowell, C. D.; McLaughlin, R. D. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 38p. (CONF-730838-1). Dep. NTIS $4.00.

From conference on instrumental monitoring for ambient air; Boulder, Colorado, USA (14 Aug 1973).

A review is given of commercial and developing methods for the detection and monitoring of gaseous hydrocarbons in the air. (9 tables, 6 figures, 36 references) (DLC)

29514 (MHSMP-73-14) ALTERNATE EXPLOSIVE TRAIN SYSTEMS FOR DRIVER SUBASSEMBLY. Final Report. Slape, R. J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.). Jul 1973. Contract DA-11-173-AMC-487(A). 20p. Dep. NTIS $3.00.

For Sandia Labs., Albuquerque, NM.

A study was made of the feasibility of replacing the present LX-13 Tetryl output pellet explosive train in the driver subassembly with one or all of three candidate systems. (DLC)

29515 (MHSMP-73-30) QUARTERLY PROGRESS REPORT, April–June 1973. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Development Div.). 1973. Contract DA-11-173-AMC-487(A). 90p. Dep. NTIS $6.50.

For Lawrence Livermore Lab.

Work is reported in the following high-explosive fields: formulation; friction sensitivity; performance and sensitivity; mechanical properties; thermal properties, reactivity, and compatibility. The explosives studied included PETN, LX-, PBX, PEX, Adiprene, etc. (DLC)

29516 (MHSMP-73-31) PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT, APRIL–JUNE 1973. Volume I. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.). 1973. Contract DA-11-173-AMC-487(A). 167p. Dep. NTIS $10.50.

Research progress on He explosives is summarized under 26 separate sections. (LMT)

29517 (MHSMP-73-33) IDENTIFICATION OF SILICONE OIL/PETN INTERACTION. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.). Jul 1973. Contract DA-11-173-AMC-487(A). 12p. Dep. NTIS $3.00.

For Sandia Labs., Albuquerque, NM.

29518 (MHSMP-73-34) SENSITIVITY TO INITIATION OF RDX SYLGARD EXTRUDABLE EXPLOSIVES BY HNAB MDF.

Hanes, L. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.). 1973. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $3.00.
For Sandia Lab., Albuquerque, NM.

29519 (MHSMP-73-35) RDX/SYLGARD INVESTIGATION. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.). 1973. Contract DA-11-173-AMC-487(A). 20p. Dep. NTIS $3.00.
For Sandia Labs., Albuquerque, NM.
The compatibility of RDX with HNAB, aluminum, and Sylgard was investigated. Methods for the quantitative analysis of the RDX/Sylgard mixture and analysis of trace amounts of HMX were evaluated. Extrudability and detonation performance of the RDX/Sylgard system were investigated. (DLC)

29520 (ORNL-4914) SOLUBILITIES OF CALCIUM SULFATE DIHYDRATE AT 25°C IN BRACKISH WATERS AND THEIR CONCENTRATES; EFFECT OF CALGON ADDITIVE AND PREDICTIONS FOR REVERSE OSMOSIS PROCESSES. Yeatts, L. B.; Lantz, P. M.; Marshall, W. L. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 64p. Dep. NTIS $5.45.

29521 (ORNL-TIRC-73-2) TOXICITY OF TRIS(2,3-DIBROMOPROPYL) PHOSPHATE AND TRIS(2,3-DICHLOROPROPYL) PHOSPHATE: A BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). May 1973. 6p. Dep. NTIS $5.00.
In this bibliography, containing 17 references, the citations are divided into three sections: toxicity of the title compounds; general toxicity of organic phosphoric acid esters and halogenated flame retardants; and manufacturer's reference data sheets. The general toxicity section is further subdivided into secondary and primary references, each arranged by year and alphabetically by first author within each year. The sources searched covered a sixty-six-year time span, from 1907 through May 1973. (auth)

29522 (ORNL-TIRC-73-3) TOXICITY OF ZINC PHOSPHORODITHIOATES: A BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). May 1973. 6p. Dep. NTIS $5.00.
In this bibliography, containing 19 references, the citations are divided into two sections: general toxicity of zinc organic compounds, phosphorodithioates, and lubricating oil additives; and analytical methods for zinc phosphorodithioates. The general toxicity section is further subdivided into secondary and primary references, each arranged by year in alphabetical order by the first author's last name. The sources searched cover a sixty-six-year time span, from 1907 through May 1973. (auth)

29523 (ORNL-TIRC-73-4) TRACE ELEMENT PROFILE ON HUMAN BLOOD: A BIBLIOGRAPHY. Gerstner, H. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Mar 1973. 14p. Dep. NTIS $5.00.
This bibliography of 117 selected references on trace elements in human blood, under both normal and pathological conditions, was compiled by the Toxicology Information Response Center in answer to a specific request. Coverage of the abstract literature spans the years 1968 to 1973. The citations are arranged chronologically by year and alphabetically by first author within each year. (auth)

29524 (ORNL-TIRC-73-5) TOXIC EFFECTS OF BEE AND WASPS VENOMS: A BIBLIOGRAPHY. Gerstner, H. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Apr 1973. 19p. Dep. NTIS $7.00.
Coverage of the abstract literature spans the years 1962 to 1973 and citations retrieved range from 1960 to 1973. These are arranged chronologically by year and alphabetically by author within each year. (173 references) (auth)

29525 (ORNL-TIRC-73-6) DISEASES AND TOXICOLOGIC PHENOMENA IN PSITTACINE BIRDS: A BIBLIOGRAPHY. Gerstner, H. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Mar 1973. 9p. Dep. NTIS $5.00.
In this bibliography of 55 selected references, coverage of the abstract literature spans the years 1962 to 1973. The citations are listed chronologically by year and alphabetically by first author within each year. (auth)

29526 (ORNL-TIRC-73-7) TOXICOLOGY AND ENVIRONMENTAL EFFECTS OF POLYCHLORINATED TERPHENYLS: A Bibliography. Gerstner, H. B. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Apr 1973. 7p. Dep. NTIS $5.00.
This bibliography contains 32 selected references. Coverage of the abstract literature spans the years 1962 to 1973, and citations retrieved range from 1959 to 1973. These are arranged chronologically by year and alphabetically by author within each year. (auth)

29527 (ORNL-TIRC-73-8) TOXICITY OF EUGENOL: AN ANNOTATED BIBLIOGRAPHY. Gerstner, H. B. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). May 1973. 12p. Dep. NTIS $5.00.
The listing contains 55 references extracted from the published literature for the period 1932 through 1972. (LMT)

29528 (ORNL-TIRC-73-9) TOXICITY OF POTATOES: A BIBLIOGRAPHY. Warren, H. S. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Feb 1973. 56p. Dep. NTIS $7.00.
This bibliography consists of 285 references and was taken from the literature of 1962 through 1972. This bibliographic review was prepared by the Toxicology Information Response Center in answer to a specific request. References are arranged alphabetically, by author, within years in chronological order back to 1944. (auth)

29529 (ORNL-TIRC-73-10) TOXICITY OF DL-MANDELIC ACID IN ANIMALS: A BIBLIOGRAPHY. Gerrard, M. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). May 1973. 9p. Dep. NTIS $5.00.
Both intact-animal studies and cell-culture studies were considered in the search that recovered 28 citations on mandelic acid toxicity. Because the number of references to the toxicity of mandelic acid and its salts (organic derivatives and esters were excluded) are few, a number of physiological effects were included even though they may not be toxic. Also a few references on other forms than dl were included. Effects on bacteria were excluded, but acidifying effects and production as metabolites in the animal body were considered pertinent. (auth)

29530 (ORNL-TIRC-73-12) TOXICITY AND METABOLISM OF BHA (2- AND 3-TERT-BUTYL-4-HYDROXYANISOLE): A BIBLIOGRAPHY. Holland, F. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). May 1973. 12p. Dep. NTIS $5.00.
This bibliography of 81 selected references results from a review of the literature of 1947 through early 1973, and citations spanning the years 1948 to 1972 were retrieved. References are listed by year in alphabetical order by the first author's last name. The majority of citations on BHA, a food additive, listed under the general heading, "Food Technology," did not deal with the titled topic; but those that did give information on metabolism or toxicity are included. (auth)

29531 (ORNL-TIRC-73-14) TOXICITY AND ADVERSE EFFECTS OF RDX: AN ANNOTATED BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Jun 1973. 7p. Dep. NTIS $5.00.
This bibliography, containing 20 references, was prepared by the Toxicology Information Response Center in answer to a specific query. The citations, concerning the toxicity of RDX (cyclotrimethylenetrinitramine; cyclonite; Hexogen; T_4), are divided into two sections, secondary and primary references, each arranged by year in alphabetical order by the first author's last name. The sources searched covered a seven-year time period, from 1965 through May 1973. (auth)

29532 (ORNL-TIRC-73-15) TOXICITY AND ADVERSE EFFECTS OF TRINITROTOLUENE (TNT): A PARTIALLY ANNOTATED BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Jun 1973. 16p. Dep. NTIS $5.00.
This partially annotated bibliography contains 71 references. The citations are divided into two sections, secondary and primary references, each arranged by year in alphabetical order by the first author's last name. The sources searched covered a seven-year time period, from 1965 through May 1973. Physiologic and toxicologic effects of TNT, incidences of industrial exposure, and a few articles on environmental impact and waste water effluent treatments following TNT manufacture are included. (auth)

29533 (ORNL-TIRC-73-16) TOXICITY AND ADVERSE EFFECTS OF AMMONIUM PICRATE: AN ANNOTATED BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Jun 1973. 9p. Dep. NTIS $5.00.
In this bibliography, containing 18 references, the citations are divided into two sections, secondary and primary references, each arranged by year in alphabetical order by the first author's last name. The sources searched covered a seven-year time period, from 1965 through May 1973. Physiologic and toxicologic effects of picric acid are also included. (auth)

29534 (ORNL-TIRC-73-17) TOXICITY, ADVERSE EFFECTS, AND ENVIRONMENTAL CONTROL OF ORDNANCE, EXPLOSIVE COMPOUNDS: A BIBLIOGRAPHY. Miller, K. C. (comp.) (Toxicology Information Response Center, Oak Ridge, Tenn.). Jun 1973. 12p. Dep. NTIS $5.00.

The citations are divided into three sections, secondary, primary, and environmental control references, each arranged by year in alphabetical order by the first author's last name. The sources searched covered a seven-year time span, from 1965 through May 1973. (71 references) (auth)

29535 (ORNL-TM-4330) CALCIUM SULFATE SCALING IN REVERSE OSMOSIS (HYPERFILTRATION) OF BRACKISH WATERS BY HOLLOW-FIBER AND SPIRAL-WOUND MODULES. Minturn, R. E. (Oak Ridge National Lab., Tenn.). Jul 1973. 133p. Dep. NTIS $8.75.

29536 (ORNL-TM-4359) MASS SPECTRA OF N-NITROSO COMPOUNDS. Lijinsky, W.; Christie, W. H.; Rainey, W. T. Jr. (Oak Ridge National Lab., Tenn.). Oct 1973. Contract W-7405-eng-26. 109p. Dep. NTIS $7.50.

Low-resolution electron-impact mass spectra (70 eV) of 95 N-nitroso compounds are presented. Aliphatic, aromatic, and cyclic nitrosamines are represented, as are nitrosamino acids and nitrosamides. (auth)

29537 (ORNL-tr-2619) PROPAGATION OF A THERMAL WAVE ON HEATING A PACKED BED OF MATERIAL WITH FLOWING GAS. III. Vetrov, B. N.; Todes, O. M. Translated by S. J. Rimshaw from Zh. Tekh. Fiz.; 25: 1242-1247(1955). 15p. Dep. NTIS $3.00.

The general case of heat exchange between a gas stream and a charge of material under nonadiabatic conditions with propagation of heat by means of thermal conductivity along the material being taken into account is considered. (JFP)

29538 (ORNL-tr-2687) STRESS-STRAIN RELATIONSHIPS OF MATERIALS IN THE PLASTIC RANGE. Wakasugi, S.; Goto, Y. Translated from Zairyo; 21: 289-294(1972). 14p. Dep. NTIS $3.00.

An empirical equation is proposed that embodies three constants to relate stress and strain of materials in the plastic range. This equation was tested on various materials by performing static tensile and compression tests and comparing the experimental values with the values predicted by the empirical equation. A comparison was also made on a few of these materials with the values obtained by the nth power equation and the Voce equation that have been used in the past. The method for determining the optimum values of the constant used in this empirical equation is clear cut, and there has been good agreement between the measured values and values predicted by the equation for a number of materials. This equation also simplifies the analysis of plastic stress waves in cases such as that involving the formation of plastic deformation waves when a longitudinal shock of fixed velocity is imparted to the end of the rod. Thus, this equation has many desirable features. (auth)

29539 (ORNL-tr-2690) RUPTURE-RESISTANCE CURVES. Morozov, E. M.; Savunov, V. T. Translated from Fiz. Khim. Mekh. Mater.; 8: No. 4, 71-74(1972). 6p. Dep. NTIS $3.00.

The possibility of calculating resistance curves for crack growth in materials using rupture diagrams obtained analytically from the integral principle of variation in the theory of crack propagation is examined. The crack length after each loading cycle is calculated and the dependence of crack length on the number of cycles is established. The length dependence determines the number of cycles to rupture and the length of the crack at the rupture point. (JRD)

29540 (ORNL-tr-2695) HEAT TRANSFER AND PRESSURE DROP IN HORIZONTAL TUBES IN FLOW OF EVAPORATING REFRIGERANTS. Chawla, J. M. Translated from VDI (Ver. Deut. Ing.)-Forsch.; No. 523, 5-36(1967). 67p. Dep. NTIS $5.50.

For the investigation of the influence of various physical variables on heat transfer and the pressure drop in an evaporator tube the local heat transfer coefficient and the pressure drop were determined as a function of the refrigerant mass flow, vapor content, heat flux, and the saturation pressure. (JFP)

29541 (ORNL-tr-2725) BRAKE DISK. Boulet, G. 2 Nov 1961. Translation by R. G. Mansfield of German Patent 1,116,484. 4p. Dep. NTIS $3.00.

A brake disc made of beryllium is designed for the landing gear of aircraft. (DLC)

29542 (ORNL-tr-2726) EFFECT OF ALKALI AND ALKALI-EARTH NITRATES ON THE LIQUID–VAPOR EQUILIBRIUM OF THE WATER–NITRIC ACID SYSTEM. Cigna, R.; di Cave, S.; Giona, A. R.; Mariani, E. Translated by M. Gerrard from Chim. Ind. (Milan); 46: No. 1, 36-45(1964). 15p. Dep. NTIS $3.00.

The investigation was restricted to lithium, magnesium, and calcium nitrates, the presence of which in the liquid phase significantly changed the composition of the two phases at equilibrium. Using ternary systems of nitric acid with the above salts, an analytical solution was found for the relative volatility of nitric acid and a graphic representation of the ebullition curve. (13 figures, 5 tables) (auth)

29543 (RLO-2225-T-26-9) ANAEROBIC METABOLISM IN LAKE WASHINGTON SEDIMENTS. Pamatmat, M. M.; Bhagwat, A. M. (Washington Univ., Seattle. Dept. of Oceanography). 1972. Contract AT(45-1)-2225. 41p. Dep. NTIS $4.25.

A method of measuring the dehydrogenase activity of sediments at 10°C was calibrated by direct microcalorimetry at the same temperature. Field measurements of dehydrogenase activity of sediments in Lake Washington were converted to rates of metabolic heat release by means of the significant regression of dehydrogenase activity on metabolic heat release. Simultaneous field measurements at 10°C of oxygen uptake by undisturbed sediment cores were converted to rates of metabolic heat release by the factor 4.8 cal liberated per milliliter of oxygen consumed. (LMT)

29544 (SLA-73-581) VORTEX-STABILIZED PLASMA ARCS AS HIGH-POWER RADIATION SOURCES. Hadley, G. R. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 24p. Dep. NTIS $4.00.

The behavior of a vortex-stabilized plasma arc was studied to determine its performance in the megawatt power range. This is accomplished by the use of a simple core model which seems to contain all the essential physical processes that make up arc behavior. Predictions made on the basis of the core model are consistent with experimental observation at lower power and should be reliable well above 10 Mw provided that blackbody conditions are avoided. (auth)

29545 (SLA-73-802) ANALOG COMPUTER SIMULATION OF AN OPTICAL TRACKING MOUNT. Bechtel, F. K.; Shaut, A. L.; Wyatt, F. V. (Sandia Labs., Albuquerque, N. Mex.). Sep 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

The process of improving the design of tracking mount systems requires testing new ideas. These tests can be performed more economically and conveniently and with better experimental control with a simulation of the tracking mount system than with the system itself. This report describes both a model of a tracking mount system and an implementation of that model on an analog computer. Coulomb friction and saturation nonlinearities are included in the model. Comparisons between results from a particular tracking mount system and its analog computer simulation provide a basis for confidence in the simulation's validity. An example involving the effects of changing sampling rate and delay in the position loop's error sensing apparatus illustrates the use of the simulation. Future tracking mount system development may include an adaptive feature which would allow the system to be optimized for a particular target trajectory. A performance criterion is suggested for use with adaptive design. (auth)

29546 (SLA-73-856) EFFECT OF STEREOREGULARITY ON THE T_g IN POLYVINYL T-BUTYL ETHER. Wischmann, K. B.; Curro, J. G. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. Contract AT(29-1)-789. 10p. Dep. NTIS $3.00.

Glass transition temperatures of three stereo isomers of polyvinyl tertiary butyl ether are reported which are inconsistent with the hypothesis of Karasz and MacKnight. (auth)

29547 (SLA-73-5632) COMPACT SUPER-STABLE LASERS AS LENGTH DIGITIZERS. Zuppero, A. (Sandia Labs., Albuquerque, N. Mex.). 1973. 14p. (CONF-730835-2). Dep. NTIS $3.00.

From meeting of the society of photo-optical instrumentation engineers; San Diego, California, USA (27 Aug 1973).

The operation, application, and working theory of an ultrastable laser as a length digitizer is summarized. The two projects presently under way, a 1.6-km (1 mile) long laser earth-strain seismometer and a 1-cm pendulum tilt meter, each with a range of 10^{-12} to 10^{-5} strain units and radians (or acceleration g units), respectively, are detailed as examples of application. Concepts in angular measurement and servo-controlled physical dimension are reviewed. (auth)

29548 (SLA-73-5708) MODERNIZATION OF SANDIA LABORATORIES' TRISONIC AND HYPERSONIC WIND TUNNELS. Peterson, C. W. (Sandia Labs., Albuquerque, N. Mex.). 1973. 28p. (CONF-730932-1). Dep. NTIS $3.50.

From 40th semi-annual meeting of the Supersonic Tunnel Association; Bedford, UK (24 Sep 1973).

Since 1956 more than 20,000 tests involving aircraft, rockets, and reentry vehicles have been made in the Trisonic and Hypersonic Wind Tunnels at Sandia Laboratories. Due to recent advances in vehicle performance, these wind tunnels are unable to reproduce realistic flight conditions, cannot meet the more stringent flow-quality requirements imposed by modern rocket and reentry systems, and cannot meet proposed standards for safe operation and proof testing. Therefore, the wind tunnel facilities are being modernized. Data are presented on the deficiencies of each wind tunnel, plans for correcting these deficiencies, calibration of existing wind tunnel instrumentation, and development of new diagnostic techniques. (LCL)

29549 (SLA-73-5763) TRAPATT DIODES AND CIRCUITS FOR HIGH-POWER MICROWAVE GENERATION. Liu, S. G. (RCA Labs., Princeton, N. J.). 1972. 22p. Dep. NTIS $3.25.

Among the known solid-state microwave devices, the Trapatt diodes have a unique capability in generating high-peak microwave power with high efficiency. Some of the developments in Trapatt devices and circuits for peak power generation in the hundred- and kilo-watt range are discussed. Device fabrication and performances of the n-type, p-type, and a recently developed double-ended Trapatt diode structure will be presented. On circuit developments, experimental circuits operating in the fundamental and the harmonic-extraction mode, as well as a miniature quasi-lumped oscillator circuit are discussed. The importance of bias impedance upon the performance of a Trapatt amplifier is also presented. (auth)

29550 (SLL-73-25) FABRICATION OF METAL CAPILLARY FLOW CONTROL DEVICES. Lindsay, P. B. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 20p. Dep. NTIS $3.00.

The internal diameter of commercial stainless steel tubing has been reduced to very small dimensions (~0.001 inch). Three approaches were used. Two of these were advanced mechanical methods, and the third was chemical vapor deposition. (auth)

29551 (SLL-73-259) COMPREHENSIVE REVIEW OF GAS PERMEATION, DIFFUSION, AND SOLUBILITY IN INORGANIC GLASSES. Shelby, J. E. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 43p. Dep. NTIS $4.25.

All reported information dealing with gas permeation, diffusion, and solubility in inorganic glasses is reviewed. The information is reported in tabular form and is intended for the designer of devices and/or systems in which gas migration may be of importance. (18 tables, 88 references) (auth)

29552 (SLL-73-5256) TURBULENT INTERFERENCE HEATING ON SEVERAL SMALL FIN CONFIGURATIONS. Coleman, H. W.; Lemmon, E. C. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

When aerodynamic control fins are used on high-velocity vehicles, regions of increased heating occur on the vehicle surface in the vicinity of the fin and also on the body of the fin itself. The flow field in such regions is complex and does not yield itself to a straightforward analytical description. It is therefore necessary to investigate this type of problem experimentally. Turbulent heating distributions are measured in the interference region on and around several small, highly-swept fin configurations mounted on a cone. (auth)

29553 (SVF-3) DISCUSSION OF POSSIBLE ABSORPTION OF CHLORINE IN MIXED BED FILTERS. Tjaelldin, O. (Stiftelsen for Varmeteknisk Forskning, Studsvik (Sweden)). Sep 1972. 23p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.25.

An investigation of the ion exchange of Cl^- ions from turbine condensates is done. The ability of different ion exchangers is shown to be very ph-dependent as well as temperature-dependent. Ion exchange of Cl^- from condensates containing N_2H_4 and NH_3 was also discussed. (SW)

29554 (SVF-9) STUDIES OF CORROSION OF HEAT EXCHANGER TUBES EXPOSED TO BALTIC SEAWATER. Arvesen, J.; Henrikson, S. (Stiftelsen for Varmeteknisk Forskning, Studsvik (Sweden)). Sep 1972. 15p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

Corrosion experiments were conducted for 1800 h at 50°C on seven stainless steels, four copper alloys, one nickel alloy, and Ti. (DLC)

29555 (TI-707-14-1) SOFIRE I-B USER PACKAGE. Johnson, R. P. (Atomics International, Canoga Park, Calif.). 5 Feb 1969. 66p. Dep. NTIS $5.50.

This SOFIRE I-B User Package contains a description of and general equations used in the Sodium Fires model. Also included is a current listing, sample data input, description of input variables, flow diagram, sample CRT display and a SOFIRE-B source deck compiled for use on the IBM-360 Model 50 computer. (auth)

29556 (TID-26450) DEVELOPMENT AND UTILIZATION OF A WAVELENGTH-SELECTIVE MULTI-ELEMENT FLAME SPECTROMETRIC DETECTOR FOR THE GAS CHROMATOGRAPH. Lodmell, J. D. (Tennessee Univ., Knoxville). Dec 1973. 119p. Dep. NTIS $8.00.

Thesis.

A flame spectrometric detection system (FSD) was constructed by connecting a gas chromatograph to a flame spectrometer using a heated stainless steel transfer line. The system included a splitter to allow simultaneous flame ionization detector (FID)–FSD chromatograms to be obtained and a special laminar flow, $N_2O-C_2H_2$, premix burner that could be heated without distortion of the flame. A monochromator provided the selective response required for the FSD and a dual-channel recorder was used to present simultaneous chromatograms of both the FID and FSD. A method was developed for the gas-chromatographic determination of cacodylic acid as an allylthiourea derivative. The FSD was used to study a variety of metal chelates including the $UO(tfa)_2$, $Cr(tfa)_3$, $Cr(hfa)_3$, $Al(tfa)_3$, $Cu(tfa)_2$, $Fe(hfa)_2$, $Cu(hfa)_2$, $Co(hfa)_2$ and tricarbonylchromium complexes (tfa = trifluoroacetylacetone) and (hfa = hexafluoroacetylacetonate). (DHM)

29557 (UCID-16260) THERMODYNAMIC PROPERTIES OF XENON IN THE FLUID REGIME BETWEEN 1 AND 10 eV. Graboske, H. C. Jr.; van Thiel, M.; Olness, R. J. (California Univ., Livermore. Lawrence Livermore Lab.). 10 May 1973. Contract W-7405-Eng-48. 30p. Dep. NTIS $3.50.

The thermodynamic properties of fluid xenon in the temperature range of 1 to 10 eV were calculated by using a variety of theoretical models. A complete thermodynamic description is best given by the combination of an equilibrium statistical mechanical model (FMIN) at lower temperatures with a statistical atom model (TFCMIX) at higher temperatures. Equation-of-state data and shock hugoniots were determined. (auth)

29558 (UCID-16275) DESIGN OF A BUILDING WALL SUBJECT TO BLAST LOADING. Baker, C. F.; Mullins, R. K. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Jun 1973. Contract W-7405-eng-48. 32p. Dep. NTIS $3.75.

A method used to modify a building wall subject to blast loading is described. The design blast load was determined by scale-model testing. A computer program is devised to predict the behavior of the single degree-of-freedom structure. The existing wall is seen to be inadequate and a new wall is designed. The existing and new-wall designs are tested to check the design calculations. The tests agree reasonably well with design calculations and the new wall is shown to be adequate. (auth)

29559 (UCRL-51013(Pt.4)) COMPILATION OF PUBLISHED INFORMATION ON ELEMENTAL CONCENTRATIONS IN HUMAN ORGANS IN BOTH NORMAL AND DISEASED STATES. 4. Data Summary Ordered by Specific Health State, Subordered by Atomic Number, Organ, and Suborgan. Robison, W. L.; Anspaugh, L. R.; Martin, W. H.; Lowe, O. A. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Jul 1973. Contract W-7405-eng-48. 213p. Dep. NTIS $7.60.

This report is the fourth of a series of compilations of the published data on the elemental content of human tissues in both healthy persons and those afflicted with one or more diseases. The objective of the series of reports is to organize this very large volume of data in such a way that it will be useful for a variety of purposes. The first report is primarily a listing of the raw data. Subsequent reports in the series are data summaries giving the mean elemental concentration in each organ from all papers coded in the system. This, the fourth report, is ordered by World Health Organization International Classification of Disease code number, and subordered by atomic number, organ and suborgan. (auth)

29560 (UCRL-51381) YOSEMITE EXPERIMENTS: HF PROPAGATION MEASUREMENTS THROUGH ROCK. Lytle, R. J. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Apr 1973. Contract W-7405-eng-48. 52p. Dep. NTIS $5.45.

A variety of cw, swept frequency, and pulse transmission experiments were conducted. The experiments involved the propagation of electromagnetic waves through more than 1000 ft of hard rock in and around the Wawona Tunnel at Yosemite National Park. In situ bulk conductivities of 2 to 5×10^{-4} mho/m and relative dielectric constants of 5 to 7 were measured in the 3 to 50 MHz band. Experimental errors in these values are estimated to be less than ±9% and ±10%, respectively. (auth)

29561 (UCRL-51390) STATIC STRESS ANALYSIS OF AXISYMMETRIC SOLIDS WITH MATERIAL AND GEOMETRIC NONLINEARITIES BY THE FINITE ELEMENT METHOD. Hartzman, M. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Jan 1973. Contract W-7405-eng-48. 33p. Dep. NTIS $4.00.

A technique for analyzing axisymmetric solids subjected to axisymmetric static loads is described. The material properties are described by elastic-plastic incremental stress-strain relations of the Prandtl-Reuss type. The complete formulation includes geometric effects due to assumed large displacements and rotations. The technique therefore incorporates both material and geometric nonlinearities. A solution is obtained by applying the finite element method and using an incremental-iterative numerical algorithm. The technique was applied to the problem of an internally pressurized thick cylinder where considerable deformation occurred. Comparison with an alternate numerical solution indicates reasonable agreement. (auth)

29562 (UCRL-51395) TABULAR EQUATIONS OF STATE: METHOD OF CONSTRUCTION AND THEIR APPLICATION TO CARBON. Ree, F. H.; Young, D. A.; Johnson, K. W. (California Univ., Livermore. Lawrence Livermore Lab.). 24 May 1973. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

The three-phase equation of state (EOS) GRAY is modified so that the resulting code, BLACK, includes a rapid method of determining parameters in the fluid EOS as well as methods of removing singularities and van der Waals loops. The EOS for carbon for temperatures from 0.1 to 100 eV and densities from 2.25×10^{-4} to 5.6 g/cm^3 is used to demonstrate the procedure. The carbon EOS is generated through the use of BLACK at low temperatures, TFCMIX at high temperatures, and an interpolation procedure in the intermediate temperature range. (auth)

29563 (UCRL-74603) MICROWAVE ROTATIONAL SPECTROSCOPY: A PHYSICAL TECHNIQUE FOR SPECIFIC POLLUTANT MONITORING. Hrubesh, L. W. (California Univ., Livermore. Lawrence Livermore Lab.). 4 Jun 1973. 14p. (CONF-730720-1). Dep. NTIS $3.00.

From technical conference on observation and measurement of atmospheric pollution; Helsinki, Finland (30 Jul 1973).

An attempt was made to present substantial evidence that microwave rotational spectroscopy can be developed for use in air-pollution monitoring. Work with the diode-cavity spectrometer shows it to be capable of detecting small concentrations of NO_2, SO_2, H_2CO, and NH_3 gas with very high specificity. (JFP)

29564 (UCRL-74922) OSCILLATION ON THE ULTRAVIOLET BOUND–FREE CONTINUA OF DIATOMIC MOLECULAR XENON AND MOLECULAR KRYPTON. Rhodes, C. K.; Hoff, P. W. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Aug 1973. 14p. (CONF-730658-1). Dep. NTIS $3.00.

From conference on laser spectroscopy; Vail, Colorado, USA (25 Jun 1973).

Oscillation was observed in high-pressure xenon and krypton gas excited by a high-current relativistic electron beam. The radiation in both cases attributed to bound–free transitions of the corresponding homonuclear molecular dimers, Kr_2^* and Xe_2^*. In the case of xenon, the stimulated line occurs at ~1722 with a 15 Å width while for krypton the stimulated emission is centered at 1457 Å with a width of 8 Å. (auth)

29565 (UCRL-74946) PICOSECOND IMAGE-CONVERTER STREAK CAMERAS FOR LASER DIAGNOSTICS. Coleman, L. W. (California Univ., Livermore. Lawrence Livermore Lab). 13 Aug 1973. 11p. (CONF-730835-1). Dep. NTIS $3.00.

From meeting of the society of photo-optical instrumentation engineers; San Diego, California, USA (27 Aug 1973).

The requirements and techniques for time-resolved (< 1 nsec) diagnostics of laser pulses are reviewed. The advantages and limitations of applying gated image-converter streak cameras to the problem of laser pulse diagnostics are discussed. The design and operation of a unique 10-psec time resolution streak camera is described. The compact size of the camera results primarily from the use of a micro-channel tube for image intensification. Optically triggered avalanche transistor circuits provide reliable, low jitter electronic operation of the streak tube. The S-1 photocathode response allows direct measurement of neodymium laser pulses. Examples of the uses of streak cameras for laser diagnostics and the data obtained are presented. Comments on additional applications and the development of streak cameras with extended capabilities are included. (auth)

29566 (UCRL-75047) CHARACTERISTICS OF PHOTOGRAPHIC PLATES AT 1060 NM. Dittmore, C. H.; Joonsar, H. (California Univ., Livermore. Lawrence Livermore Lab.). Aug 1973. 23p. (CONF-730930-2). Dep. NTIS $3.25.

From electro-optical systems design conference; New York, New York, USA (18 Sep 1973).

The results of an investigation of the characteristics of Kodak emulsion Type I-Z for use in neodymium laser diagnostics are described. Calibration of this emulsion, proper darkroom techniques for acceptably hypersensitizing large numbers of these plates, and certain sensitometric comparisons are presented. (auth)

29567 (UCRL-Trans-10706) MICROCHANNEL PICOSCOPE: A HIGH-TEMPORAL-RESOLUTION SWEEP TUBE FOR STUDY OF LIGHT PHENOMENA IN THE SUBNANOSECOND RANGE. Clement, G.; Delmare, C.; Loty, C. Translated from Acta Electron.; 15: No. 4, 369-371(1972). 7p. Dep. NTIS $3.00.

The Picoscope tube was achieved as the first stage of a study carried out on a streak camera tube. In its design, this photodetector tube has a particularly interesting performance both in time resolution and dynamic range. The Picoscope is aimed at displaying the evolution versus time-of-flight events in the picosecond range. Designed like a cathode-ray tube in which the conventional cathode is replaced by a photocathode, this tube makes use of the gain and high-speed properties of a channel electron multiplier array (microchannel plate). The luminance of the spot on the screen is proportional to the illumination of the photocathode: the light gain is 10^3 and the dynamic range is 10^2. The high-speed spiral scanning (2 cm · ns^{-1}) allows luminous phenomena of 100 ns duration to be displayed with a resolution of 10 ps. (auth)

29568 (USGS-3002-2) HYDRAULIC TESTING ACCOMPANYING DRILLING OF FIVE EXPLORATORY HOLES, PICEANCE CREEK: COLORADO. Weir, J. E. Jr.; Dinwiddie, G. A. (Geological Survey, Lakewood, Colo. (USA)). Sep 1973. Contract AT(49-16)-3002. 67p. Dep. NTIS $5.45.

29569 (Y-1884) EDDY-CURRENT SEAM TRACKER FOR ELECTRON-BEAM WELDERS. Henry, J. J. (Oak Ridge Y-12 Plant, Tenn. (USA)). 11 Jul 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

An eddy-current seam tracker has been developed for making high-precision welds with an electron-beam welder. This tracker employs an "E-frame" seam detector probe and operates as a servo follower for maximum tracking accuracy. (auth)

29570 (Y-EF-564) ELECTRICAL SAFETY IN THE RESEARCH LABORATORY. Hoy, H. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 24p. (CONF-721044-2). Dep. NTIS $3.25.

From meeting of the national safety congress; Chicago, Illinois, USA (30 Oct 1972).

An Electrical Advisory Committee at ORNL developed an organized group of "research safety guidelines" because of the very complex research being performed. Credible hazards are described here, and proper steps to minimize them are outlined. (LMT)

29571 SHUAIBA SOUTH: 800 MW and 36 MILLION GALLONS OF FRESH WATER FOR KUWAIT. Elec. Light Power, E/G Ed.; 51: No. 17, 48-49(Sep 1973).

The world's largest desalination plant extracts heat from six steam turbines. Each distillation unit is to provide 6 million gallons daily from the Arabian Gulf. Natural field gas normally flared at the refinery is used as the boiler fuel at no cost. The various equipment is described; a mimic board similar to a reactor control panel is used to determine the condition of various components. (DLC)

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